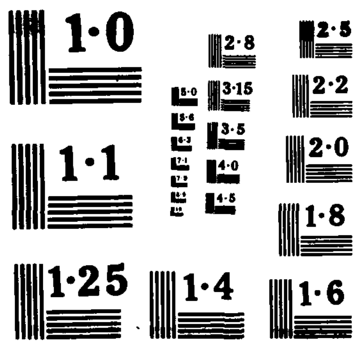
AD-A212 971 NATO'S ANTI-TACTICAL BALLISTIC MISSILE REQUIREMENTS AND THEIR RELATIONSHI..(U) RAND CORP SANTA MONICA CA D RUBENSON ET AL. DEC 87 RAND/R-3533-AF 1/1

UNCLASSIFIED F49620-86-C-0008 F/G 15/3.1 NL

END
FILMED
12-89
DTIC


1·0
2·8
2·5
3·15
2·2
5·0
3·5
2·0
1·1
4·0
4·5
1·8
1·25
1·4
1·6

AD-A212 971

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER R-3533-AF	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) NATO's Anti-Tactical Ballistic Missile Requirements and Their Relationship to the Strategic Defense Initiative		5. TYPE OF REPORT & PERIOD COVERED Interim
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) D. S. Rubenson, J. L. Bonomo		8. CONTRACT OR GRANT NUMBER(s) F49620-86-C-0008
9. PERFORMING ORGANIZATION NAME AND ADDRESS The RAND Corporation 1700 Main Street Santa Monica, CA 90406		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Long Range Planning & Doctrine Div. (AF/XOXFP) Directorate of Plans, Ofc DCS/Plans & Operations Hq USAF, Washington, D. C. 20330		12. REPORT DATE December 1987
		13. NUMBER OF PAGES 52
14. MONITORING AGENCY NAME & ADDRESS(If different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

No restrictions

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

NATO
West Germany
Space Warfare
Ballistic Missiles

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

See reverse side

DD FORM 1 JAN 73 1473

This report attempts to structure the broad range of issues affecting the potential development of anti-tactical ballistic missile (ATBM) systems by evaluating the relationship among NATO's potential needs for ATBMs, the technologies under development in the Strategic Defense Initiative (SDI) program, and the political constraints in the Federal Republic of Germany (FRG), where ATBMs would be deployed. The authors conclude that planners attempting to improve NATO's air defenses and those attempting to advance SDI research goals are faced with distinctly different problems. Since NATO's requirements have little connection to SDI, an ATBM system intended to advance SDI goals must be based almost entirely on SDI objectives and could cause controversy in the FRG. Conversely, the limited systems of most interest to NATO stand outside the political debate.

R-3533-AF

NATO's Anti-Tactical Ballistic Missile Requirements and Their Relationship to the Strategic Defense Initiative

David Rubenson, James Bonomo

December 1987

A Project AIR FORCE report
prepared for the
United States Air Force

RAND

PREFACE

This report attempts to structure the broad range of issues affecting the potential development of Anti-Tactical Ballistic Missile (ATBM) systems by evaluating the relationship among NATO's potential needs for ATBMs, the technologies under development in the Strategic Defense Initiative program, and the political constraints in the Federal Republic of Germany where ATBMs would be deployed.

The analysis draws on earlier RAND studies in presenting an unclassified treatment of the ATBM issue. The report is intended to contribute to the public debate that has grown around the question of how NATO should respond to a threat that has not fully developed. The method is to give possible responses to potential technological developments in the Soviet threat. The analysis does not to any significant extent consider clues provided by Soviet military doctrinal writings as to how the threat may develop.

Independent of the approach, any analysis of emerging threats will be subject to great uncertainty. It is not possible to rigorously treat all parts of such a complex subject in one concise volume. Instead, the direction of major trends is indicated and general recommendations are developed. The report should provide an organized structure for evaluating a complex issue, in which more information can be incorporated as it becomes available. The study was undertaken as part of a project entitled "Concept Development and Project Formulation," conducted in the National Security Strategies Program of RAND's Project AIR FORCE.

* * * * * * * *

Most of the analysis described in this report was conducted prior to the rapid progress in negotiations on a potential ban on all tactical ballistic missiles of ranges greater than 500 km. As the report was being completed, it appeared that such an agreement would be reached. The authors have attempted to indicate how such a treaty may affect the issue of NATO's ATBM needs, however, they have not significantly modified the analysis or the discussion.

SUMMARY

POLICY QUESTIONS

The potential development of Anti-Tactical Ballistic Missile (ATBM) systems has become an important and confusing defense policy question. ATBMs could constitute a European extension of the Strategic Defense Initiative (SDI) measure for population defense. It has also been mentioned as a mechanism for early demonstrations of SDI technologies, while remaining within the Anti-Ballistic Missile (ABM) treaty and satisfying NATO's current military requirements. Or NATO military needs might justify ATBMs without consideration of SDI.

The different roles for ATBMs have created a number of political and military issues that must be clarified before purposeful ATBM policies can be developed. Most critical is whether or not ATBMs are needed to meet current or foreseeable NATO requirements, and if so, whether those needs imply the use of SDI technologies. If needed by NATO, planners must recognize the extent to which opposition to SDI might undermine support for ATBMs. If NATO's needs do not provide a basis for demonstrating SDI technologies, then SDI planners may want to understand the political feasibility of developing an ATBM that goes beyond NATO's requirements.

The first-order assessment of these issues given here requires judgments on technical and political factors that are subject to great uncertainty. We indicate where we believe these factors will lead, with our reasons. We attempt to reach conclusions despite the uncertainties, because assessments like these are needed to formulate longer term policies. This report not only reflects our current understanding, but also allows for key issues to be identified so that new information can be incorporated as it becomes available.

NATO'S ATBM NEEDS

The Policy Problem

The rationale most often given for an ATBM system based on current NATO doctrine is the potential improvement in the accuracy of Soviet TBMs, which would allow the TBMs to be armed with conventional warheads. This potential capability has produced great

concern about the Soviet ability to use such weapons as a major element of a surprise attack. ATBM development is a logical response; however, funds for ATBMs will have to be drawn from other military programs. ATBM functional similarity to Soviet offensive air suggests that traditional air defense might be the source of these funds. The need for defenses against possible cruise missiles, drones, and standoff missile threats might also be included in the competition for resources. **NATO's policy problem is thus to develop responses to the potential TBM threat that account for uncertainty in the future mixture of the overall air threat.**

The Role of Conventionally Armed TBMs

We therefore concentrate on how TBMs might be used in a conventional theater conflict and on their role in relation to the aircraft threat and the air-breathing threat in general. **We argue that the large numbers of Soviet aircraft already in existence, and the large payloads these aircraft carry, make it highly unlikely that TBMs will be the preferred Soviet mechanism for delivering large quantities of munitions. We also argue that improvement in accuracy alone is inadequate to make TBMs an effective weapon system.** Advances in warhead technology will also be required. Attacking nonfixed targets requires solutions of guidance and acquisition problems that go well beyond accuracy improvement. **We conclude that the first generation of accurate conventionally armed TBMs which may appear in the 1990s will only threaten targets that are soft and fixed, and that the Soviets would be likely to use such TBMs only in cases where TBM speed offers a unique advantage over subsonic delivery.**

We then review the NATO target base. Only for targets directly related to NATO air defense, such as surface-to-air missiles (SAMs), airbases, and certain command and control centers, will TBM speed offer significant advantage over subsonic delivery. Furthermore, the transportability of SAMs and the hardening of fixed command centers reduce the vulnerability of these targets. Fixed SAMs would be highly vulnerable, but their replacement by transportable systems would reduce this vulnerability and increase their survivability against air-breathing threats. **Thus, the problem is largely one of airbase vulnerability.** For airbase defense, passive defenses provide an alternative to ATBMs, appear to be less expensive, and simultaneously counter the aircraft threat. Many of the techniques already planned for implementation against the air threat will greatly reduce the vulnerability of airbases to TBMs. Thus, even if the conventional TBM

threat never appears, passive defenses would represent a worthwhile investment. However, the effectiveness of airbase defense by passive means alone is limited by the land available for military use in the Federal Republic of Germany, and ATBMs may eventually be needed as a supplement; there is, however, no immediate need for ATBM deployment. **We conclude that passive defenses will provide adequate protection of airbases against conventional TBM attacks throughout the 1990s.**

Chemical and Nuclear Armed TBMs

ATBMs have also been mentioned as a means of countering or deterring chemical and nuclear threats. Few argue that ATBMs could, in the near term, provide a credible defense against large nuclear attacks. However, improved accuracy would allow the Soviets to execute nuclear missions with significantly reduced weapon yield, thereby reducing collateral damage. Some argue that this will increase Soviet interest in limited nuclear options, hence implying a role for ATBMs. Also, the dual conventional and nuclear role would further increase the rationale for ATBM development.

We attempt to state conditions under which ATBMs would be needed to deter limited Soviet nuclear options. **We examined two generalized scenarios and argue that reduced warhead yield will not in any obvious way increase the rationale for ATBMs.** We further argue that the requirements for a defense against nuclear armed TBMs and conventionally armed TBMs are so different that the dual use argument provides no important justification for ATBMs.

We point out that the chemical TBM threat is only one component of a much larger military and political problem associated with chemical weapons. As with conventional warheads, TBMs are only important in that their speed or assured penetrability may offer some unique advantage. We argue that the existence of such situations is not obvious and active defenses for protection against such scenarios play only a minor role in coping with the effects of chemical attack. We conclude that some combination of passive defenses, arms control, and threat of retaliation will be the dominant factors in deterring chemical attacks.

NATO'S NEEDS AND SDI

These arguments imply little connection between NATO's needs and the Strategic Defense Initiative. Since ATBM deployment is not

needed, there is no immediate requirement for deployment of SDI technologies. This also seems true of NATO's research plans. NATO might eventually need ATBMs as a supplement to passive defenses of airbases and a limited number of other targets, against a conventional threat. Research on traditional ground-based radars and interceptor technologies should satisfy these needs. More ambitious programs, using advanced and highly innovative SDI technologies, offer the opportunity for better performance, but imply increased costs and technical risks. However, there is little need for NATO to engage in these risks now if ATBMs are only to supplement passive defenses, providing a hedge against a threat which has not yet appeared. NATO's ATBM research can proceed in an evolutionary manner without having to take risks to overcome gaps in current preparedness.

POLITICAL QUESTIONS

Since NATO does not require early deployment, its ATBM needs are unlikely to arouse significant political controversy. However, if deployment is eventually needed, NATO planners must be aware of how the connection, real or perceived, between SDI and ATBMs may affect support for deployment. A more immediate issue is whether an ATBM system, going beyond NATO's needs for the purpose of demonstrating SDI technologies, could be supported in Europe, where SDI has been controversial.

We limit our discussion to the Federal Republic of Germany (FRG), where ATBMs would be deployed. The German defense minister has discussed ATBMs in public forums, and in so doing, has pushed the issue outside the immediate circles of security specialists. We first examine the possibility that SDI issues, when applied to an ATBM program, might increase the appeal of ATBM development. We argue that the role of ATBMs in technology development, or in decreasing decoupling fears created by SDI, is not likely to be persuasive. Support for ATBMs will be based almost exclusively on their contribution to meeting NATO's needs. An ATBM system going beyond these needs will find little new support.

We then examine the possibility that ATBMs could become a source of controversy, even if based on NATO's needs. We review the ATBM debate that has taken place in the FRG and observe that most arguments have been made without regard to specific concepts and missions. **We conclude that limited concepts which emphasize traditional ground-based technologies, and which we believe are consistent with potential NATO needs, stand outside the**

political debate that has emerged to this point. More ambitious concepts using SDI technology will heighten political concerns, the significance of which cannot at this time be estimated. However, given NATO's military requirements, there seems little need now to pursue potentially controversial concepts.

CONCLUSIONS

We conclude that planners attempting to improve NATO's air defenses, and those attempting to advance SDI research goals, are faced with distinctly different problems. Since NATO's requirements have little connection to SDI, an ATBM system intended to advance SDI goals must be based almost entirely on SDI objectives. This would create few enthusiastic supporters in the FRG, and could result in significant controversy. Conversely, the limited systems of most interest to NATO seem to stand outside the political debate. However, NATO's needs could change in unexpected ways. The limitations on passive defenses, the costs of ATBMs as we now understand them, and the potential political controversy associated with advanced ATBM concepts all imply that it would be difficult to counter a highly refined threat. Such a refined threat would involve TBM deployments far in excess of those predicted and development of refined munitions and dispensing mechanisms. One means of preventing such a threat from developing is an arms control agreement limiting the number of Soviet TBMs.

At the time this report was being prepared, it appeared that the current U.S.-Soviet negotiations on intermediate-range ballistic missiles might lead to a ban on all TBMs with ranges above 500 km. This would eliminate a significant portion of the threat, but still allow the Soviets to develop conventionally armed TBMs that could strike important targets. It would also eliminate the possibility that the SS-23 missile constitutes a near-term or immediate threat. Such an agreement would therefore constitute a partial solution to the conventional TBM problem. Limitations on missiles below 500 km would also be desirable in terms of meeting the conventional TBM threat in the future.

CONTENTS

I. INTRODUCTION

ATBMS AND SDI

The potential development of Anti-Tactical Ballistic Missile (ATBM) systems has become an important and confusing defense policy question. Widely differing ATBM systems have been discussed, for widely different military missions. Advanced systems might constitute a European extension of strategic defense of the United States. More modest systems have been mentioned as a near-term method of demonstrating technology from the U.S. Strategic Defense Initiative (SDI), while remaining within the Anti-Ballistic Missile (ABM) treaty and serving current military needs.[1] Recently two prominent policymakers, German Defense Minister M. Woerner and U.S. Senator Pete Wilson, have drawn attention to the potential improvement of Soviet conventionally armed tactical ballistic missiles (TBMs).[2] Such a development might imply a role for ATBMs within current NATO strategy, independent of SDI.

The potential military utility of such a NATO-ATBM[3] is an old issue that has become more visible during the present SDI debate. Technological advances have increased the likelihood that the Soviets can make their short-range ballistic missiles sufficiently accurate for efficient use with conventional warheads. Improved accuracy would indicate that the Soviets could use vastly reduced yields in implementing theater nuclear options, thereby reducing collateral damage. Such a development might imply new dimensions to NATO nuclear strategy and a role for ATBMs. Despite these issues relating to current military strategy, the discussion surrounding active defenses for NATO has been heavily mixed with issues related to SDI. Some SDI critics see NATO-ATBM as a "cover" for European participation in SDI. Conversely, SDI supporters see an increased rationale for NATO-ATBM,

---

[1]This was most prominently suggested in the Future Security Strategy Study, Fred S. Hoffman (Study Director), *Ballistic Missile Defenses and U.S. National Security*, Summary Report, October 1983.

[2]M. Woerner, "A Missile Defense for NATO Europe," *Strategic Review*, Winter 1986, p. 13, and Senator P. Wilson, "A Missile Defense for NATO: We Must Respond to the Challenge," *Strategic Review*, Spring 1986, p. 9.

[3]We will use the term NATO-ATBM to indicate an ATBM system that would be developed to serve NATO's military needs within the context of current theater strategy. When we refer to the military utility of such a system, we are referring only to its application in NATO and not its potential contribution to SDI. If such a system incorporated any SDI technology it might incidentally benefit SDI research goals.

since it might demonstrate SDI technology. Still others argue that a NATO-ATBM is needed to keep European defense current with the new strategic and technological opportunities that SDI will create.[4]

PROBLEMS AND OPPORTUNITIES: THE RESEARCH ISSUES

The mixing of SDI and NATO military issues presents a number of potential problems and opportunities for both NATO and the SDI program. NATO could benefit by the development of technologies within SDI that could help counter the TBM threat. However, such a connection might increase the level of political controversy, even if ATBMs could be justified by NATO's requirements alone. The connection to SDI might draw attention away from potentially cheaper and simpler "passive defense" techniques that might counter the threat. The SDI program might benefit by helping to meet existing military needs through early deployment of key technologies, thereby increasing the rationale for the entire program. ATBM deployment might also allow for SDI technologies to be tested. Conversely, if use of SDI technologies is not the optimal solution for NATO, we may be creating false impressions about the utility of these technologies for near-term military applications.

These possibilities point to a number of questions and issues that must be resolved before creation of purposeful ATBM policies. The greatest need is for a clear understanding of NATO's ATBM needs and an explanation of how those needs depend on the SDI program. This would help identify which of the above possibilities are important considerations and which are not. A better understanding of political issues related to ATBMs is also needed, particularly in Europe where SDI has been highly controversial. NATO planners must understand the extent to which the real or perceived connection between ATBMs and SDI might undermine support for a NATO-ATBM program. SDI planners will be interested in knowing if an ATBM program going beyond NATO's needs, for the purpose of demonstrating SDI technologies, might be politically acceptable, especially if NATO's needs are not heavily dependent on SDI technologies.

In our attempt to explain the potential military, technological, and political relationships between SDI and NATO-ATBM, we first describe NATO's ATBM needs under existing doctrine and financial constraints. We examine the potential capabilities and limitations of

[4]This is our impression of the theme of Dr. Woerner's speech "Strategie im Wandel . . ." at the International Wehrkundetagung in Munich, March 1, 1986.

conventionally armed Soviet TBMs which might be deployed over the next one or two decades, consider how they might be used against the most important NATO targets, and describe methods for countering them. Opportunity costs are addressed by placing TBMs in the context of the overall air threat to NATO. Also considered are the implications of Soviet nuclear attacks with low-yield weapons, and the role of ATBMs in deterring such attacks.

Having arrived at what we believe to be a reasonable estimate of NATO's future ATBM needs, we then discuss the kinds of ATBM technologies that should be of interest to NATO. The relationship between NATO-ATBM and SDI and opportunities for technology sharing are described. We then discuss relevant West German political issues. The FRG defense minister has expressed a specific interest in ATBMs, and, in discussing them in public forums, has pushed the ATBM issue beyond the immediate circles of security specialists. Our focus on the Federal Republic of Germany is also appropriate given the intensity of the German defense debate, and the geography that makes the FRG the country that must accommodate ATBM deployment, perhaps singularly.

II. ATBMS AND THE CONVENTIONAL MISSILE THREAT

The relationship between NATO-ATBM and SDI is of course directly related to NATO's ATBM needs. We first consider the threat posed by conventionally armed TBMs, which have become the most publicized rationale for NATO-ATBM. We then turn to the chemical and nuclear threat before developing an estimate of NATO's needs.

THE CONVENTIONAL THREAT AND NATO'S POLICY PROBLEM

NATO-ATBM has become an increasingly visible concern because of the possible improvement in the accuracy of conventionally armed Soviet TBMs. With accuracies of several hundred meters, such weapons could be used for conventional missions, but the large CEPs imply that many missiles would miss the target and are unlikely to be cost effective. However, some projections indicate that by the 1990s Soviet TBMs may achieve significantly improved accuracies, allowing for more efficient attacks with conventional munitions.[1] The absence of defenses against such a threat, combined with the delivery speed, has led to dire predictions about the Soviet ability to initiate a surprise attack and quickly terminate a conventional war on favorable terms. Under Secretary of Defense Fred C. Iklé has argued that conventional TBMs could provide the Soviets with

> a conventional strike capability that could destroy a significant part of NATO's military capability . . . they could launch devastating attacks on major military installations, such as airfields, command and control nodes, air defense installations, targets that heretofore

[1]We are generally referring to the SS-23 and 21. The SS-20 is assumed to carry only nuclear warheads. The SS-12 Mod II may also have conventional roles, but there seems to be more uncertainty in regard to this missile. The ongoing negotiations over theater ballistic missiles may lead to a ban of the SS-12, 12 Mod II, 20, and 23. A prospective treaty may not affect the SS-21 and would allow development of a new Soviet missile with range up to 500 km. The improvement in CEP was discussed by Dr. Richard DeLauer, then Under Secretary of Defense for Research and Engineering, in late 1984 (see p. 3 in the *Washington Times*, November 1, 1984). Another reference to potential TBM accuracies can be found in *Aviation Week and Space Technology*, July 7, 1986, p. 84. In *NBC Defense & Technology International*, April 1986, Senator Daniel Quayle refers to the accuracies of the SS-21, 22, and 23 as expected to improve to 50 m CEP.

> could be attacked in a surprise attack only only by crossing the nuclear threshold.[2]

Such arguments are supported by the many references in Soviet military writings to the advantages of preemption and surprise.[3]

NATO is thus seen by many to face a new threat that would seem to accomplish many of the goals of Soviet offensive air power, but with significantly greater speed and surprise. The functional similarity with air power has led many to adopt the term "extended air defense" in categorizing potential methods of countering the threat. The label also highlights a policy dilemma. Funds for countering tactical ballistic missiles will compete with other priorities, and most likely with traditional forms of air defense. The German Ministry of Defense (MOD) estimates that the Soviets may be able to generate 10,000 aircraft sorties per day in the 1990s.[4] Since a portion of this threat already exists, there will be understandable hesitancy to divert funds to counter a threat that has not yet appeared. The "extended air" threat might also include cruise missiles, drones, and antiradiation weapons. NATO's principal policy challenge is to understand the relative importance of TBMs within an uncertain mixture in the overall air threat, so that scarce resources can be properly allocated. Overestimating the TBM threat and developing responses that are specific to the TBM threat could lead to a dangerous reduction of funding for other air defense needs. Earlier studies have been useful in drawing attention to Soviet TBMs; what is now needed is a discussion of the limitations and capabilities that these weapons may possess.

There is no rigorous analytical method for making such an assessment. Doctrinal arguments provide general guidance, but give no indication of what engineering problems might or might not be overcome. They provide little indication of Soviet investment decisions for individual weapon systems. At best we can apply analytical techniques to those small parts of the problem where they are appropriate, make

[2]Testimony before the U.S. Senate Committee on Armed Services Subcommittee on Strategic and Theater Nuclear Forces, April 24, 1986.

[3]This is effectively argued by Dennis M. Gormley in *Orbis*, Vol. 29, No. 3, Fall 1985, pp. 537–569.

[4]H. H. Weisse, "Implications of Soviet Tactical Missile and Anti-Tactical Missile Capabilities on NATO's Strategy," prepared for the European American Workshop, October 9–11, 1986, Washington, D.C. Dr. Weisse is a member of the MOD planning staff. It is perhaps presumptuous to assume that Dr. Weisse is speaking with the voice of the ministry in his paper; however, the estimate cited here was also informally voiced to us by other members of the MOD. The figure is used in J. Koepke and K. Olshausen, "Flug Koerperabwehr in NATO-Europe," *Wehrteknic*, October 1986, an article by two Bundeswehr officers. We believe that the estimate may be overstated, but it does in any case illustrate the potential magnitude of the aircraft threat to NATO.

reasoned arguments drawing on available data in other areas, and consider the effects of different policies within the scope of the uncertainties. These caveats obviously apply to the following discussion. Despite the scope of what is not known, analyses like the following, and the judgments contained within, are needed to formulate long-term policies. They also provide a basis for identifying key issues so that new information can be incorporated as it becomes available.

CONVENTIONALLY ARMED TBMS: LIMITATIONS AND CAPABILITIES

The Military Role

Conventionally armed TBMs have become important because improved TBM accuracy is an achievable objective. However, we should not allow the tendency to focus on a single accuracy parameter to obscure other factors relevant to determining the utility and effectiveness of TBMs. One such factor is its potential cost effectiveness. A TBM like the SS-23 can only deliver about a 1000-kg payload.[5] This may be sharply reduced if terminal guidance systems if are used to obtain improved accuracies.[6] The payload will also be reduced by any weapon dispensing system for ejecting submunitions. Analogies with NATO missile design studies indicate that the SS-23 might carry as little as 500–600 kg of munitions.[7] Such a missile would likely cost millions of dollars if developed by NATO.[8] Aircraft have better cost-to-

[5]Institute for Defense and Disarmament Studies, *World Weapon Database*, Vol. I, *Soviet Missiles*, by Barton Wright, D. C. Heath and Co., Lexington, Massachusetts, 1986, pp. 377 and 395.

[6]As an example, we estimate that the system used on the Pershing II weighs at least 300 kg. This is based on the total Pershing II payload and the mass of the B61 bomb, both in *Nuclear Weapons Databook*, Vol. I, *U.S. Nuclear Forces and Capabilities*, by Thomas Cochran, William Arkin, and Milton Hoenig, Ballinger Publishing Co., Cambridge, Massachusetts, 1984, pp. 65 and 294.

[7]This is based on our estimate for the weight of a terminal guidance system combined with the weight of dispensing systems found in "A Ballistic Approach to AXE for Airfield Attack Weapon AAW," unclassified briefing by Boeing Aerospace Company, Seattle, Washington, 1982.

[8]Conceptual design estimates for a conventionally armed Pershing II are around $3 million. See D. Cotter, "Potential Future Roles for Conventional and Nuclear Forces in Defense of Western Europe," *Strengthening Conventional Deterrence in Europe*, the American Academy of Arts and Sciences, 1983. Such early cost estimates typically rise during design and development.

payload ratios, and historical attrition rates are only 1–3 percent.[9] An aircraft can be used many times, a TBM only once. The cost effectiveness of aircraft is also increased by the pilot who can to some extent adapt to a changing situation. Modern air defenses may increase attrition above historical rates, and there are a wide range of predicted values for Soviet aircraft attrition. Nonetheless, from the standpoint of merely delivering quantities of munitions, historical attrition rates make it seem highly unlikely that TBMs will be more cost effective than aircraft as a means of delivering large quantities of munitions.[10]

This argument can also be supported by considering the total payload capabilities that Soviet Frontal Aviation and Soviet conventionally armed TBMs may have in the 1990s. Soviet ground attack bombing capabilities have been estimated to be more than 7500 metric tons and rapidly increasing.[11] Unclassified projections indicate that they may in the future make several hundred launchers available for conventionally armed TBMs.[12] Using payload estimates stated above, TBM volleys using all available launchers may carry on the order of a hundred tons. It seems unlikely that the Soviets would develop this capability merely to supplement the bombing capability of Frontal Aviation. Consequently, the authors conclude that aircraft should remain the major mechanism for inflicting large levels of damage on a military target. TBMs will be attractive only where the delivery speed and assured penetrability offer an important advantage and when attacks by small payloads can have a significant military effect.

---

[9]In *Air Power and the Nuclear Age,* M. J. Armitage and R. A. Mason list two recent cases, the U.S. bombing of Hanoi and Haiphong in December of 1972 and the first few days of the 1973 Arab-Israeli War (University of Illinois Press, Urbana, Illinois, 1983, pp. 110 and 127). In the December 1973 case (Linebacker II), the United States lost 16 B-52s out of 729 sorties, a rate of 2.2 percent. In the Yom Kippur war, Israel lost 3 percent of their attack sorties in the first 48 hours. In both cases, the attrition rates were rapidly falling functions of time.

[10]Assuming a cost of $30 million for an aircraft with a 4 metric ton delivery capability and $3 million for a TBM capable of carrying one metric ton implies attrition rates of 29 percent would be required to make the cost comparison equal. A TBM payload estimate of 500 kg combined with a $10 million cost per airplane implies a 79 percent attrition rate. In either case, the attrition rate is so high that air forces would cease to be useful. The Soviets obviously believe this is not the case, as evidenced by their continued investment in manned aircraft and the associated infrastructure.

[11]See *Soviet Military Power 1987,* the U.S. Department of Defense, p. 77.

[12]Gormley's *Orbis* estimate of 274 is typical. Estimates like these were made before the apparent rapid progress in negotiations on intermediate-range nuclear weapons. Unclassified reports of these negotiations indicate that the SS-23 and SS-12 Mod II would be banned, possibly reducing the projected numbers even more. However, the SS-21 would not be affected, nor would new missiles of under 500 km range.

Distinctions between Attacking Fixed and Transportable Targets

An important distinction between fixed and nonfixed targets has not been captured by the public focus on accuracy. The low CEPs potentially achievable with a terrain matching sensor pertain only to fixed targets, where detailed terrain maps can be developed.[13] Equally accurate guidance systems for use against mobile or transportable targets present additional technical challenges beyond simple improvements in missile accuracy, such as in sensing and computing, where the Soviets have traditionally lagged the United States by many years.[14] The most often discussed guidance approach, a terrain matching sensor, would require that a detailed map of the area around the mobile target, specific to the terminal sensor, be transmitted to the missile. This map can be generated only after the target is found, and must be transmitted before the target moves again.

Using a purely inertial system to avoid this difficulty is problematic. High-quality inertial guidance may produce small guidance errors, but reentry errors may be substantial when a bulky conventional warhead must be used. This may also apply when a midcourse update is used to enhance accuracy. The United States has little operational test data on how conventional warheads and dispensing packages will degrade accuracy. We can only say that terminal correction just prior to weapons release is the surest method of minimizing potential problems.

A third alternative would be to use a less accurate TBM, and to rely on "smart" submunitions to search out the target. This eases accuracy and reconnaissance requirements. Primitive versions of such submunitions were tested in the U.S. Assault Breaker program and should be part of NATO's FOFA, Follow-On Forces Attack. However, Soviet development of systems that could overcome simple countermeasures and locate targets in a variety of terrain conditions is probably many years away.

Another means of coping with the demand for high accuracy is to use dispersed submunition patterns to extend the lethal radius of the weapon. Assuming a 900-kg payload (100 kg for dispensing, no weight loss for terminal guidance), about 60 15-kg munitions might be deployed. This would allow an area of about 250 m diameter to be blanketed with a minimum overpressure of at least 5 psi, assuming the

---

[13]Cochran et al., p. 295.

[14]For example, the U.S. Department of Defense has stated in regard to computing that "Although the Soviets have a solid understanding of basic principles, they have lingering problems in applying this knowledge. . . . The Soviets remain 10 years behind the west," *Soviet Military Power 1987*, p. 112.

submunitions could be deployed in a uniform deployment pattern. This implies that only fairly soft targets could be killed.

By restricting the targets of interest to soft targets, such as air defense radars, the need for terminal guidance may not arise. However, it would still be necessary to locate transportable targets to accuracies on the same order as the lethal radius of the pattern, about 125 m. If the target of interest radiates, and the radiator is collocated with important target functions, airborne ELINT (electronic intelligence) systems might detect the target. The ELINT system must be capable of sorting through the hundreds, if not thousands, of signals in the Western European electronic environment. Modern U.S. airborne direction-finding (DF) systems should be able to provide location accuracies a few percent of the detection range after triangulation. This results in a several kilometers error with 100 km surveillance ranges, and is obviously inadequate for use with conventionally armed TBMs.

The United States has for many years contemplated development of an airborne ELINT system using the signal time difference of arrival (TDOA) from three separate airborne platforms. The Precision Location and Strike System (PLSS) has a design goal of detecting and locating enemy emitters to accuracies of about 50 ft CEP from distances of 300 km,[15] althought practical limitations may increase location CEPs significantly. Such problems include the need to obtain optimal geometries while maintaining an unobstructed line of sight for three aircraft simultaneously.[16] Some analyses also suggest that as greater accuracies are obtained, new sources of error will be encountered, limiting the ultimate performance of the system.[17] Testing of the PLSS began in 1985. Production plans were postponed in 1986 after $600 million in development costs were spent. Some proponents maintained that the system could have been made to function properly, while others maintained that system integration and data processing were major problems. Given adequate funding, it seems logical to assume that the United States could design and deploy an operational TDOA system in the 1990s that would dramatically improve our ability to locate radiating targets. Whether such a system could reliably detect targets to errors of 100 m or less at relevant geometries and

---

[15] *Aerospace Daily*, Vol. 138, No. 42, May 29, 1986.

[16] Optimal performance is obtained when the aircraft are separated by angles of 120 deg as measured from the emitter. However, such geometries cannot be approached when surveying NATO radars from Warsaw Pact territories. Simple geometrical analyses can show that error factors of 5 to 10 or more may not be uncommon for geometries relevant to the European theater.

[17] See, for example, T. F. Burke, *Limitations on TOA Accuracy*, The RAND Corporation, P-6386, September 1979.

ranges in a survivable mode will require further testing and actual operational data. In any event, the system would be very expensive. Three on-station TR-1 aircraft would be required, with at least 24 aircraft needed for coverage of all corps fronts in Europe.[18] Lifetime cost estimates for the first two aircraft have been reported as $1.1 billion.[19] The entire system would thus be very expensive unless costs could be shared with other missions.

Attacking nonradiating targets involves even more demanding technology. Airborne synthetic aperture radars (SARs) might be used to "photograph" vast regions of West Germany; however, the data processing involved, and more importantly, the data interpretation, are extremely demanding tasks. "Smart" software would have to be developed in order to rapidly identify targets in the photographs. Nor do high-resolution photographs guarantee accurate aimpoints. Small bias in aircraft measurements may not degrade image quality but could provide significant aimpoint errors. Thus, to use SARs for targeting would require not only massive data processing and interpretation, but would also require that potential target locations be analyzed in comparison with landmarks of known locations.

Providing aimpoint information in the rear[20] involves the development of high-performance airborne sensors, the solution of formidable C^3 data processing, and data interpretation problems. An alternative solution is to obtain the information at much closer distances. For example, drones using direction-finding technology flying 10 km from a radiating air defense radar might provide surveillance information good to 200 m, assuming a 2 percent of range capability. This is at best marginal for TBMs against very soft targets. Such a technique probably could not be used to provide targeting information prior to the war for preparation of an initial TBM strike. It also seems illogical to use a drone to transmit less than adequate targeting information through a potentially complicated C^3 net. If penetration can be achieved, it seems far more logical to use homing antiradiation missiles (ARMs) to attack the target directly. The same can be said of *Spetsnaz* (special) forces. If the Soviets are able to penetrate key NATO units, or have enough special troops to track transportable targets over the landscape, it seems more logical for these forces to implement the limited attacks themselves than attempt to measure and transmit targeting data.

---

[18] *Jane's Defence Weekly*, September 7, 1985, p. 494.

[19] *Ibid.*

[20] Since airborne sensors might fly at least 50 km behind the front for survivability, even relatively forward positions might require long surveillance ranges.

Another approach might be to use crude surveillance information along with knowledge of local terrain conditions and target terrain requirements. For example, if ELINT could localize a radiating target to 25 sq km and if the target had to be deployed on a specific terrain, such as a hill top, significantly better location errors might be obtained. Detailed target and terrain analyses are needed before the authors can determine the scope of this problem. The Soviets will be working with less precise information. Their commanders will not know what spots are optimal or which spots have limitations not visible on maps. Nor can they assume that targets are deployed only in optimal locations. Even reading a map to the required accuracies is not easy. Standard tactical maps are 1:50,000 scale, implying 0.2 cm for each 100 m. Failure to localize to distances equivalent to the submunition pattern would force the Soviets to multiple aimpoint attacks. Given the limited number of TBMs being projected, only extremely valuable targets might be attacked in this manner.[21] It again seems more logical to use whatever imprecise knowledge exists in combination with ARM weapons to attack radiating targets of uncertain location.

The combination of human and technical intelligence introduces uncertainties in the target location task that are difficult to predict. Attacking nonfixed targets with TBMs by purely technical means would require advances in a wide range of technologies. The Soviets would need to develop new reconnaissance, surveillance, and data handling capabilities, and will be challenged in computing and sensing, where they have traditionally lagged. All of the functions must be accomplished before the target moves again. The platforms must be survivable. In many cases, the required developments go beyond existing or planned U.S. capabilities. Some of the developments will involve technical challenges that far exceed the more publicized development of accurate missiles. Overcoming all of these problems would present major challenges for western technology and would seem to be a distant goal for the Soviets. Use of human intelligence could reduce these technical demands, but the authors conclude that such information is in general better suited to supplementing modes of attack other than TBMs. Still, for a small number of time-critical, militarily significant, and locationally constrained targets, the Soviets might overcome modest target location uncertainties by striking multiple aimpoints with TBMs.

---

[21]Simplistically, the number of aimpoints is proportional to the area in which the target may be located and hence to the square of the target location error.

Warheads

Development of conventional TBM warheads may in fact reduce TBM capabilities. A random, explosive, dispersal of cluster munitions should be a relatively straightforward technical challenge. Other developments will require more research, development, and testing. Runway cratering submunitions or mines must be designed and packaged in a TBM warhead. The dispersal of submunitions, especially fuel air explosives (FAE), is a more complicated problem for TBMs than for aircraft. The vulnerability of many targets to TBMs is dependent on control of the submunition patterns emerging from the missile. An earlier study of conventionally armed TBMs examined four submunition dispersal mechanisms.[22] Simple mechanisms, such as gas bags or explosive foams, produce poor pattern control. Heavier mechanisms, using launch tubes, produce only "reasonably controlled patterns," suffer from "mechanical complexity," and have an obvious loss in payload.[23] Also important is the relationship between dispensing and missile accuracy. The great speed of TBMs implies that even short-lived perturbations can result in significant inaccuracies when great precision is needed. Similarly, the development of earth-penetrating warheads for attacking hardened targets would not seem to be a near-term prospect. Such warheads would result in either large payload reductions or limited damage regions, and seem plausible only with nuclear weapons. This should remain the case until TBM accuracies improve another order of magnitude.

Developing Capabilities with Conventionally Armed TBMs

We do not imply that conventionally armed TBMs cannot be made into militarily useful weapons. But the scope of the problems that must be solved, involving warheads, reconnaissance, and guidance systems, indicates that highly effective and flexible TBM systems are not likely to emerge suddenly. Many years of testing and an evolutionary development cycle will be required.

Despite these difficulties, conventionally armed TBMs would support Soviet interest in surprise and preemption in unique ways. They might provide a mechanism for attacking NATO targets in the rear with speeds far greater than can be achieved with aircraft. In the

[22] "A Ballistic Approach to AXE . . . ."

[23] The payload loss from these more complex mechanisms was assessed to be as high as 700 lb in the Boeing study. However, it should be remembered that the missile considered carried about twice the payload as the SS-23.

absence of ATBMs, they offer an assured penetration capability. Thus, TBMs seem particularly suited to attacks on time-critical targets, particularly if such targets can be temporarily paralyzed by small quantities of munitions, allowing time for follow-on air attacks to permanently disable the target.

Any attempt to determine how rapidly various capabilities can be obtained implies an evaluation of the pace of Soviet technological progress in a wide variety of areas, including some in which the United States has little technical experience, such as dispensing supersonic warheads. Estimates must also be made of Soviet budget constraints and Soviet commitment to these programs in the face of inevitable programmatic and fiscal problems. Although such judgments will be highly uncertain, they are necessary if NATO is to plan against future threats.

In making our own estimates, we assume the previously referenced policymakers were basing their concerns on the first visible products of a Soviet research program. We also assume that doctrinal arguments, such as those presented by Gormley, indicate a Soviet commitment to the effort. We speculate that initial flight testing occurred within the last few years and assume that this represents the early stages of a development program.[24] It might logically involve the testing of existing missiles and a crude version of new warheads containing submunitions. Such a system might be effective against some fixed and very soft, or distributed, targets. Softness would be important as the imprecision requires that submunitions be spread over a large area to overcome inaccuracy. Hence, only a small portion of the payload will actually strike the target. Assuming the initial appearance of such a weapon system in 1985, we would guess that remaining problems in dispensing, warhead design, and munitions would be overcome and the weapon might be operational before 1990, although the solution of all technical problems could take longer.

It would also be logical to assume that the Soviets would not take this initial step on munitions without planning further advances. We therefore guess that the Soviets are developing some type of improved, innovative, guidance system in order to obtain improved accuracy. Assuming that development is well along in the laboratory, subsystem testing might begin shortly. Simultaneous development of mines, runway cratering munitions, and dispensing systems might also be taking place.

[24]The Soviets have for many years deployed fairly inaccurate TBMs with unitary warheads. Such weapons have little military effect and in no way constitute a technology base for more effective conventionally armed TBMs.

Given the need to develop guidance, new munitions, and new dispensing techniques simultaneously, and to integrate these technologies into a warhead that can reenter the atmosphere without causing unacceptable errors, it would not be unreasonable to assume that development of such an integrated weapons system would encounter many design problems and require extensive testing and refinement. We would guess that such a weapon system would not be in the arsenal before the mid or late 1990s. The weapon's exact capabilities (accuracy, munition pattern control, payload, etc.) are impossible to predict.

The above assumes that a development program for modifying the SS-23 is under way. If an arms control agreement is reached that bans deployment of the SS-23, we would expect development of the threat to be delayed. A new missile with a range clearly less than 500 km might have to be developed, and terminal guidance and munitions packages modified to accommodate their insertion in a different missile. Although much of the technology might be in place, the initiation of new programs with new specific conditions will inevitably produce delay.

Development of the surveillance, data processing, command and control, and the reprogrammable terminal guidance system possibly needed to attack transportable targets by technical means alone would, in the authors' judgments, be beyond Soviet capabilities in the 1990s. Soviet development of airborne TDOA technology over a limited frequency band cannot be excluded, but given the precision measurements and processing required to obtain accuracies needed for TBM targeting, the difficulties in obtaining optimal geometries, and the general level of precision associated with Soviet sensing and computing, we doubt that the Soviets will be able to efficiently support TBMs with this technology in the 1990s. It would seem more logical for the Soviets to develop ARMs combined with airborne direction-finding ELINT as a means of attacking radiating targets. Such an approach is indicative of a more reasonable balance between external surveillance and weapon homing and would seem more applicable in general to the problem of attacking nonfixed radiating targets.

There are of course other possible interpretations of the evidence. It would not be unreasonable to assume that the development pace might go somewhat faster. Conventionally armed TBMs might be deployed in greater numbers than discussed here and the reported missile flight reliabilities of 0.75 might be improved.[25] One could even assume that the Soviets could deploy a TDOA system and associated networking to develop a limited strike capability against transportable targets.

[25]This figure is reported in International Institute of Strategic Studies (IISS), *The Military Balance*, London, 1981–1982, p. 128.

In the opposite direction, one might also credibly assume that technical problems in warhead and munition development will limit development to explosively deployed cluster munitions, and that mines or runway cratering submunitions will not be developed. Thus it can also be plausibly argued that the Soviets may determine that development problems are more formidable than originally thought, and that other weapon systems are more promising. The range of uncertainty is thus large, and coping with this range is NATO's policy challenge.

Notwithstanding this range of uncertainty, in the authors' judgment the conventional TBM threat in the 1990s will largely be constrained to fixed and relatively soft targets, and only in those cases where the TBM speed and assured penetrability offer a unique advantage over air delivery. Most critical would be those NATO targets that could be temporarily paralyzed by small quantities of munitions, allowing time for Pact aircraft to arrive with larger payloads. The use of TBMs in this manner, and the protection of these types of targets, should be NATO's first concern. Given the magnitude of the still dominant Pact aircraft threat, and the technical and operational difficulties involved in using TBMs in other ways, providing protection of other NATO targets should be a lower priority. However, given the uncertainties, this estimate must be coordinated with an analysis of the military implications of TBMs to determine how variations in our estimates may affect NATO's needs.

III. USING CONVENTIONALLY ARMED TBMS

In the previous section we considered two criteria that should be satisfied before considering active defenses. First, the target must be vulnerable to conventionally armed TBMs. Attacking soft and fixed targets would require less ambitious developments than would be needed to attack transportable or hardened targets. Second, the Soviets must choose to use TBMs as opposed to other delivery vehicles. Targets that are time urgent, and can be damaged by small quantities of munitions, appear to be the logical choices. In this section, we relate these conclusions to specific targets and consider the military implications of variations in our estimates. We also consider a third criterion: the availability of passive defense options.

NATO AIRFIELDS

Of all potential assets, NATO airfields may best meet the vulnerability criteria to Soviet TBMs. Airbases, particularly the runways, are vulnerable, fixed, and highly time-critical targets. Destroying aircraft in shelters would require direct hits from conventionally armed TBMs and is unlikely unless TBM accuracies are almost perfect. The preceding arguments imply that attacks on support equipment or personnel would be more efficiently executed by aircraft. Runways, however, are critical to the immediate operation of an airbase. Their fixed locations and the long distances needed for takeoff and landing, imply that TBMs might pin-in NATO aircraft by attacking runways, without destroying the aircraft or the base infrastructure. Other targets on the base could then be attacked at a later time by Soviet aircraft. TBMs and aircraft could thus work synergistically. Small quantities of runway cratering submunitions or scatterable mines delivered by TBMs could have a military effect far greater than is indicated by the payloads delivered.

As an example of the advantages provided by TBMs, one could imagine a highly coordinated, preemptive, Soviet TBM strike against NATO Main Operating Bases (MOBs) at the onset of a war. Analytical modeling has shown that as few as six to eight SS-23 TBMs carrying runway cratering submunitions could, with 90 percent probability,

temporarily close an 8000 ft runway and parallel taxiway.[1] Since TBMs carry only small payloads, such attacks would produce limited numbers of runway craters and result in only temporary base closure. However, NATO aircraft would be "pinned-in," allowing Soviet aircraft to arrive within an hour without opposition from NATO air defense aircraft. These aircraft could then close the base for an extended period. In this scenario, the distinctive TBM advantages of speed and penetrability outweigh the disadvantage of limited payload.

Although TBMs play a unique role in this scenario, aircraft still inflict the vast majority of damage. In response to this larger threat, many passive defenses have already been planned. It is logical to examine the effectiveness of these techniques against the TBM threat before considering defenses that may be specific to TBMs. The logic of first looking at passive defenses is also increased by the potential costs of ATBMs. A Patriot fire unit (a surface-to-air missile system), costs more than $72 million (1986 dollars).[2] Any system capable of intercepting TBMs should cost at least as much since the higher speed of TBMs, compared with aircraft, implies greater stresses on the defensive system.

Airbase Passive Defense

One passive defense option that is potentially cost effective against even a highly refined threat is the construction of redundant runways. A second runway at a base might cost around $5 million and would more than double the number of TBMs needed to close the base.[3] Unfortunately, not all MOBs could accommodate even one additional air strip. Visual inspection of maps indicates that 17 of 25 MOBs might do so, but engineering and logistical constraints could lower this number. More land might be acquired, but one should not underestimate the difficulty in doing so in the FRG, where military land use is a sensitive political subject. However, simply paving over the region between the runway and the taxiway might increase Soviet TBM

---

[1]Based on the authors' calculations using RAND's TSARINA model. Closure is deemed to be achieved when there are no 50 × 3500 ft runway strips available. The differences between six and eight represent the differences in missile flight reliability. The lower number is based on 0.90, which may be typical of U.S. systems, and the higher number on 0.75, which the IISS assigns to Soviet systems (see *The Military Balance*, 1981–1982, p. 128).

[2]David Dreyfuss of The RAND Corporation has estimated this cost from the relevant Selective Acquisition Reports (SAR) (private communication).

[3]The nonlinearity results from the fact that we have assumed the same probability for overall base closure. Thus, to obtain a 90 percent probability of closing a base with two runways, each runway must be closed with approximately 95 percent probability.

requirements by 50 percent.[4] Thus, additional runways are an important potential mechanism for increasing the numbers of TBMs that might be needed to close an airfield.

Dispersal and mixing of aircraft offer another potential method of increasing Soviet TBM requirements. NATO's air defense interceptors in the Federal Republic of Germany are currently concentrated on a small number of bases. The above estimates imply that almost all of NATO's air defense interceptors might be pinned by TBM forces well below the cited projections. Redeployment to NATO's full complement of 25 operating bases (preferably accompanied by the dispersal of necessary support equipment) has obvious benefits, as would dispersal away from MOBs to other military airfields. This might increase the number of targets to 50 or 75. Still, the true effectiveness of dispersal is highly dependent on the effectiveness of Soviet TBMs. If only six to eight TBMs are needed to close a base, then only 150–200 TBMs would be needed to target the set of 25 MOBs. Doubling the number of targets would imply that 300–400 TBMs would be needed to target the entire set of 50 military airfields. Such numbers are not grossly inconsistent with projections concerning the number of conventionally armed TBM launchers the Soviets may have in the 1990s.[5] The military value of closing an airfield would surely encourage the Soviets to build an adequate number of TBMs, if they were as efficient as described above. Six to eight TBMs might cost between $18 and $24 million (assuming a cost of $3 million per TBM) but could pin-in a far more valuable set of aircraft. Dispersal beyond the limited set of military airfields is both politically and operationally questionable.

There are, however, several reasons to believe that Soviet TBMs will not be as efficient as described above, so that greater numbers will be needed to close an airbase. This will enhance the benefits of dispersal, particularly in relation to the size of the numerical threats predicted. A few airbases already have redundant air strips and a few have significantly longer strips than assumed in the above calculations. In both cases, the number of TBMs needed for closure will be larger. In the above referenced calculations, we also assumed highly dispersed and

---

[4]The value of 50 percent was based on the following assumptions. Munitions from the TBMs used to target the runway and taxiway would also strike the region between these two strips with equal density, if we assume the highly dispersed ring submunition patterns mentioned in the text. The runway and taxiway constitute approximately one fourth of the total width of the paved configuration and would still be closed with 90 percent probability. To maintain a 90 percent probability for closing the equivalent of four such widths, each must be closed with 97.5 percent probability. Our TSARINA results indicate that about 50 percent more TBMs would be needed to do this. The effect would be even greater for tightly bound cluster patterns of munitions.

[5]Gormley predicts 274, Weisse "several hundred."

precise ring patterns of runway cratering submunitions. This allowed the runway and taxiway to be attacked simultaneously, and hence the base could be attacked with only two aimpoints,[6] significantly reducing the importance of missile reliability. However, the effectiveness and required weight for such a dispensing mechanism have not been demonstrated or studied, and we did not include estimates of payload penalty or dispensing system performance in our analysis. The effectiveness of attacking the runway and taxiway simultaneously, and leaving large numbers of submunitions in between, is highly sensitive to the precise geometry of the pattern and the numbers of submunitions and hence to the actual TBM payload.

An approach with different technical assumptions might be to consider more tightly bound cluster patterns of penetrators.[7] Such patterns are less sensitive to payload and do not depend on precise geometric patterns. Using such an approach, an airbase might be attacked using four aimpoints, two on the runway and two on the taxiway. An arriving highly accurate TBM could lay craters across the runway with a high probability when such patterns are used. Four arriving TBMs could close the base. However, the need for all four aimpoints to be struck implies that eight to 12 TBMs would be needed to obtain a 90 percent closure probability.[8] This still assumes a minimum operating distance of about 3000 ft, a conservative assumption. An F-15E could not land without a braking parachute, but other NATO aircraft do not require this long a distance. Moreover, the F-15E takeoff distance should be only 900 ft.[9] The Soviets will undoubtedly assume (perhaps correctly) that such aircraft can still take off from an airbase attacked in such a manner and recover at another base or at an emergency landing strip on the German Autobahn, thus negating the pin-in effect. The Soviets must either settle for a pin-out effect alone or hit six or eight aimpoints. Such a requirement can be enforced by the adoption of arresting gear to lower aircraft landing runs. The numbers of TBMs

---

[6]The base was assumed to consist of a runway (8000 × 150 ft) and a parallel taxiway (8000 × 50 ft) separated by 650 ft. The two aimpoints were both located between the runway and taxiway, each 1333 ft from the center of the configuration.

[7]The number of TBMs needed to close a base is extremely sensitive to patterns. The effectiveness of the tightly bound cluster pattern is not highly sensitive to pattern shape or numbers of kinetic energy penetrators, but is highly sensitive to missile accuracy and controlling munition dispersion. The numbers used in the following discussion are typical of many different pattern types. A less effective pattern, but perhaps the least technically demanding, would be large random patterns of penetrators with aimpoints between the runway and taxiway. Such patterns would require more TBMs than indicated in the following discussion.

[8]The lower number is again based on 0.90 reliability, the higher number on 0.75.

[9]Takeoff and landing distances are from *Jane's All the World's Aircraft, 1984–1985*, Jane's Publishing House, New York, p. 448.

needed would then be dramatically increased. The six aimpoint case would require 12 to 24 TBMs, the eight aimpoint case 16 to 32. The spread is again due to assumptions about missile reliability. These numbers would increase still further if additional runways, or filling in the region between the runway and taxiway, were implemented simultaneously.

Although we cannot know the precise number of TBMs needed to close a base without a detailed description of a Soviet TBM, increased numbers have important implications for the attractiveness of dispersal. If, for example, the number of TBMs needed to close an airbase is 12–16 rather than 6–8, dispersal to 50 airbases would stretch Soviet TBM requirements well beyond the 274 predicted by Gormley to 600–800.

The uncertainties involved in implementing a successful TBM attack also suggest the value of implementing simple damage assessment measures, such as making helicopters available for estimating the condition of a runway. Given the demanding requirements, it is possible that Soviet TBM attacks will fail to close an airbase. However, the shock of such an attack and the need for the base commander to verify that the attack failed, could delay operations. The implementation of shorter takeoff distances also requires that the undamaged region of the strip be identified. Thus, there will be substantial benefits for rapid damage assessment, even with ATBMs, assuming some leakage.

Implementation of passive defenses involving a combination of aimpoint proliferation, rapid assessment, and recovery will help counter munitions other than runway penetrators. For example, mines might be able to block key pathways between aircraft shelters and the runways. This would not close a base, but it could disrupt operations long enough to prevent NATO aircraft from contesting a follow-on Soviet air attack. However, rapid assessment and proliferation of pathways can counter this threat. Such passive defenses are also useful against mines delivered by aircraft or cruise missiles. The same can be said of proliferating mine sweeping equipment, such as the heavily armored ORACLE vehicle.

Another passive defense technique might be to repair the runway before the follow-on air attack. Since TBMs carry limited payloads, only a few craters might need to be repaired. However, the most optimistic estimates of runway repair times are around two hours, and significantly longer times have been observed in simulated wartime conditions. If the follow-on air attack occurs within an hour of the TBM attack, there would seem to be little value in refining repair operations as a means of countering the TBM attack. The Soviets may indeed find a way to achieve the follow-on air attack within an

hour, but there seem to be uncertainties and exceptions. Despite the enormous growth in Soviet offensive air power, it seems unlikely that the Soviets could attack a majority of NATO's MOBs on the first sortie. This limitation will be increased if NATO moves forward with dispersal operations. For those bases to be attacked on the first sortie, there would also seem to be some uncertainty. The massing of Soviet aircraft shortly before a TBM attack could provide warning to NATO, though such indicators will always be ambiguous. The Soviets may recognize that increased activities on airbases might provide tipoff, and they may want to maintain a low activity level until after the TBM attack has been launched. However, the time needed to move from quiescent Soviet airbases to placing massive numbers of aircraft above NATO airfields, having passed through the forward surface-to-air missile (SAM) belts, is likely to be significantly longer than the flight time to the NATO bases. Thus, despite the fact that runway repair will probably never be quick enough to counter a perfectly coordinated attack, there seem to be a number of firm and more speculative reasons for believing that improved runway repair times will aid in countering the effects of a TBM attack.

Airbase Defense: Conclusions

Although the above discussion is dominated by uncertainty, as is any discussion of emerging threats and war in Europe, a few broad conclusions can be drawn. Airbases are vulnerable, fixed, and highly time critical targets, whose temporary paralysis would have a significant military effect. Despite the limitations on TBMs discussed in the preceding section, airbases would seem to be inviting targets for conventional TBMs in the 1990s. The Soviets will probably need many more TBMs than "perfect" models indicate, but it is undoubtedly worth many TBMs to close even a few of NATO's bases. There are a variety of passive defense techniques against TBMs that can simultaneously counter the traditional air threat to bases, and indeed many have already been planned because of the aircraft threat. Given their relatively low cost, and their capabilities against aircraft, it would seem logical to implement the passive techniques before considering ATBM deployment. Passive defense techniques have definable limitations, particularly against a highly refined threat which includes the ability to deploy runway cratering submunitions with geometric precision while not degrading missile accuracy, improvements in overall weapon reliability, and deployments in larger numbers than the cited projections. There are also political difficulties in obtaining land for military use in the FRG. These limitations, plus the possible evolution of the threat

in time, suggest ATBMs would be an important, but longer term, option for protecting airbases.

SAM SITES

Perhaps the most often discussed targets for TBMs besides airbases are SAM sites. SAMs are time critical targets, and temporary suppression would support all Soviet air operations, particularly the initial follow-on air attacks against airbases discussed above. SAM radars are probably vulnerable to lightweight submunitions, such as combined effect munitions. The rationale for protecting SAMs is also increased by the possibility that they may be upgraded to provide self-defense against TBMs. This appears to be a logical way to develop ATBM technology without procuring systems that cannot simultaneously counter aircraft.

Many factors are involved in making any decision to upgrade SAMs. SAMs are vulnerable to a wide range of threats (antiradiation missiles, cruise missiles, drones, and aircraft), and could employ mobility, decoys, and radar silence to counter these threats. One must question if a separate solution for TBMs is needed, when these techniques seem especially well suited for countering them. Transportability presents severe targeting and missile guidance problems for any TBM attack, as discussed in the previous section. The prospects of even crudely locating SAMs at the onset of the war, when TBMs offer the greatest advantage, seem particularly remote. NATO's command and control system will be intact and SAMs should be able to maintain silence. If this is less true during war, it is also true that the importance of surprise and speed is greatly reduced, implying that TBMs are not likely to be the preferred weapon for attacking a SAM. ARMs, launched from aircraft that can circle near a SAM and wait for a strong radar signal to provide homing information, should be far more effective. Such a weapon does not require perfect targeting information and does not have demanding guidance problems. Continued improvement in implementing the passive defense techniques already used to counter the range of threats to SAMs is essential for SAM survival and should be effective against TBMs.

Despite the demanding target location requirements, some analysts argue that transportability may not be adequate to protect SAMs against TBMs. As discussed in the previous section, the use of crude surveillance information, combined with human intelligence, may provide reasonably accurate targeting information to the Soviets. Since SAMs are time-critical, soft, and important military targets, the

Soviets might be willing to overcome modest target location uncertainties by striking multiple aimpoints. Such attacks might take many TBMs to succeed, but the military value of suppressing even a small number of SAMs could be large. Upgrading SAMs to have some ATBM capability might then be highly effective since the Soviets may have to increase the number of TBMs intended to strike each aimpoint.

Despite this potential benefit, any SAM upgrade must be viewed in terms of penalties it may impose on the air defense function, which is the reason for having SAMs. Because SAMs are designed to cope with a slow-moving transverse threat in ground clutter, it would be surprising if the ATBM function was completely compatible with the air defense role. Simple changes, such as in software controlling a radar, might cost little, but might also buy little ATBM capability. If such small upgrades provide any credible capability, they would introduce uncertainty into Soviet plans, as mentioned above. Larger upgrades, including new missiles and radars, raise the cost of the system and so probably decrease its cost effectiveness against aircraft. A small upgrade program for Patriot may cost little, and may not penalize the air defense mission. However, if more significant upgrades produce sharply increased procurement costs or decreased mobility, the tradeoff between the upgrade and buying more non-ATBM-capable Patriots should be carefully studied. The use of decoys, protective screens, or attempts to counter Soviet surveillance systems represent other potential alternatives to upgrades, while also helping to counter the air threat. Thus, any decision to upgrade SAMs must be preceded by detailed analysis of the specific upgrade and other defense techniques. Such analysis must include the level of protection provided against both TBMs and the overall air threat.

COMMAND AND CONTROL BUNKERS

There are a variety of other valuable NATO assets, but few seem to require active protection against TBM attacks. For most of these targets, attack by aircraft is likely to remain the major threat. The difficulties in finding and targeting mobile targets, such as command posts and missiles, suggest they would be unlikely targets for conventionally armed TBMs. Fixed command and control bunkers are easily targeted, and many have important, time-critical functions. However, all important time-critical bunkers are hardened to some degree, making it unlikely that they can be attacked by lightweight munitions from a TBM. A direct hit with a unitary warhead would be required to be

effective, calling for even more demanding accuracy. An earth penetrating warhead may be required to attack a well-designed bunker. Softer bunkers could be hardened to increase the difficulties in attacking these targets, also providing additional protection against air attacks. Communication gear for command posts could also be attacked, but additional redundancy is probably a cost-effective answer, and one that would again provide increased protection against the threat.

NUCLEAR STORAGE SITES

Nuclear weapon storage sites will generally be empty, the weapons dispersed, and will not be inviting targets for TBM attacks. Some argue that NATO cannot count on dispersal, that NATO may misread Soviet preparations for war, and given the obvious hesitancy to disperse nuclear weapons, will fail to do so before the war begins. Even accepting this argument, and assuming the weapons are still in storage sites at the time of the attack, the nuclear weapons themselves could not be efficiently attacked by conventionally armed TBMs. Instead, weapon dispersal might be delayed by attacks on mobile dispersal equipment. This would require that the equipment be parked in vulnerable positions known to the Soviets prior to the attack. Even if all of these conditions are met, the bulk of Soviet air power will likely be dedicated to the air battle during the first phase of the war. One must then ask when the large follow-on air attack could occur and whether it could occur before dispersal operations were again continued.

It should also be noted that the time criticality of attacking nuclear storage sites does not dictate the use of TBMs, even assuming that dispersal can be delayed by small payloads. Since dispersal of large sites would take many hours to complete, the flight time of a TBM offers no significant advantage over subsonic delivery. Even though the bulk of Soviet air power will initially be dedicated to the air battle, making it difficult to implement a large air attack on storage sites, even a small number of aircraft would be better suited to the mission than TBMs. Aircraft can more easily pinpoint the location of dispersal equipment. Subsonic cruise missiles would offer at least the same capabilities as TBMs, since the longer arrival time presents no significant disadvantage. Special forces might also be employed. Thus, even if we accept the argument that dispersal can be delayed by small payloads, it would only indicate that the operations themselves are far too fragile and must be made more resilient through redundancy and hardening.

There are 13 nuclear artillery shell storage sites within 100 km of the border that may take as little as two hours to disperse.[10] If not dispersed at the beginning of a war the flight times of TBMs might offer some advantages, assuming that a significant portion of the site can be emptied in the time it takes for a subsonic vehicle to reach such a forward site. If this is the case, the Soviets then might consider diverting TBMs from support of the initial air battle (attacks on airbases and possibly SAMs) in order to attack such sites and delay dispersal. Although we do not know how the Soviets would make such trades, given the uncertainties associated with light attacks on storage sites, the possibility that dispersal may have already occurred, and the potential importance of the air battle in the opening minutes of the war, the authors cannot conclude that dedicated protection of such sites against TBM attacks is a major priority.

OTHER TARGETS

A wide variety of soft area targets could be attacked by TBMs, such as POMCUS[11] sites, ports, and troops in the field. However, these targets do not have the same time criticality as air defense assets and so can be more effectively targeted by Soviet aircraft, after suppression of NATO air defense. It seems highly unlikely that the Soviets would use TBMs to attack these targets in a cost-effective manner. It can of course be argued that a target like a POMCUS site may have a special time criticality (though still not as critical as air defense) and therefore might be targeted by TBMs to effect some kind of delaying action. However, the precise mechanism by which delivery of small quantities of munitions could achieve this is unclear. Even if we assume it can be done, the arguments above on the time criticality of nuclear storage sites would apply.

This discussion is not intended to exclude all other targets from the list of those requiring special protection against TBMs. Certainly a variety of soft targets will be vulnerable to TBMs and scenarios will almost certainly exist in which the flight times of TBMs will offer the Soviets an important capability. Still, the number of important scenarios is likely to be small, as is the number of targets. For those targets and scenarios that do seem important, a tradeoff between active and passive defenses will have to be made. Since TBMs deliver only modest payloads, it is likely that in many cases vulnerabilities can be alleviated by simple passive defenses whose implementation has been

[10] See *The Wall Street Journal*, February 26, 1986, p. 29.

[11] Prepositioned Overseas Materiel Configured in Unit Sets.

long neglected. In any event, the tradeoff between active and passive techniques must consider their relative performance against TBMs and against the overall air threat before any decision can be reached.

TBMS AND THE NATO TARGET BASE

Despite many uncertainties, a few general observations can be made about how TBMs might be used against the NATO target base. The number of targets vulnerable to TBMs in the 1990s may be small. Although we have not exhaustively analyzed the NATO target base, it appears that only for those targets that in the narrowest sense involve the air battle, such as SAMs, airbases, and certain command and control centers, does the speed of TBMs clearly offer a real advantage over subsonic delivery. Even for these targets, aircraft should provide the actual means of destruction, and passive defenses against TBMs help counter the air threat. These passive defenses should ensure the protection of SAM sites and command and control centers against TBM attacks and will significantly reduce the vulnerability of airbases. Airbase defense by passive techniques alone could, however, eventually be inadequate and active defense remains a future option. Therefore, NATO's ATBM needs can best be met by research programs oriented toward providing protection of a few point targets. The availability of passive defenses, and a realistic appraisal of the TBM threat, appear to eliminate the need for ATBM deployment at this time. ATBM research can proceed in an evolutionary manner without the need to take large risks to fill immediate gaps in NATO preparedness.

IV. ATBMS AND CHEMICAL AND NUCLEAR THREATS

It appears that passive defenses alone may be adequate to counter the potential conventional TBM threat in the 1990s. Passive defenses generally make the target less vulnerable, and are also desirable because they can cope with a variety of Soviet delivery vehicles in addition to TBMs. This remains true for passive defenses against chemical attacks, although passive defenses cannot counter nuclear attacks against soft and fixed targets. ATBMs could have an advantage if a single system could counter conventional, chemical, and nuclear TBM attacks simultaneously.

CHEMICAL

Chemically armed TBMs are an old threat that has received new attention with the growing concerns about Soviet TBMs. Although there are uncertainties regarding weather and lethality, accuracies associated with the current Soviet TBMs should be adequate for effective chemical attacks. Whether the Soviets would use a weapon system that is so highly dependent on local target weather conditions and contains such extraordinary escalation risks is a much debated question. NATO's uneven and hesitant preparations may reflect this uncertainty as well as the uncertainty about NATO's policy for deterring such attacks. These uncertainties should be kept in mind when considering the potential role of ATBM in a Soviet chemical attack.

As with conventionally armed TBMs, the most important targets are those where TBM speed may offer the Soviets an operational advantage. Many NATO targets may be vulnerable to chemical attacks from TBMs, so nearby personnel must be prepared to counter them. A massive NATO commitment to passive defenses, such as personnel suits, shelters, and warning sensors is the only possible protection.

Of particular interest are attacks on those air defense related targets where TBM speed may provide a qualitative difference. For airbases, there are some uncertainties in creating the desired pin-in effect. In addition to meteorological uncertainty, pilots in closed shelters may well be shielded from harmful effects for enough time to "suit up" and enter the cockpit. Chemical attacks on airbases may be more effective when combined with runway cratering submunitions. Even if repair

crews are appropriately suited, the gear will significantly slow repair operations. The use of just the protective mask has been reported as particularly troublesome in warm weather conditions. However, the repair process itself does not have the same time criticality as the pin-in problem. Repair will take at least two hours in the best of circumstances. Chemical attacks from subsonic cruise missiles or aircraft would have an equally debilitating effect on repair operations.

Precursor chemical attacks on SAM sites and command and control bunkers are also unlikely to justify the expense of ATBMs. Well-designed ventilation systems for underground command posts should eliminate the effects of chemicals and would be needed in a protracted chemical conflict. Modern SAM systems can operate for short times with minimal human interaction. Chemical attacks with TBMs might be effective if they could prevent personnel from switching to automatic operation. Even with ATBMs, such preparations would be needed, because personnel will have to be prepared to cope with system leakage. Over a longer time period, there will be no distinction between chemical attacks from TBMs or other delivery vehicles on the performance of SAM systems.

These arguments are not intended to minimize the severity of a chemical attack on NATO. Such an attack could have devastating consequences. It is highly uncertain whether even a prepared defense can be effective. However, uncertainty in NATO's overall policy for deterring chemical attacks, and the variety of methods by which chemicals can be delivered, lead the authors to conclude that ATBMs are a relatively small detail in a very large problem.

NUCLEAR

Another NATO-ATBM military issue involves Soviet TBMs in nuclear roles. Considering the immensely more complex physical environment produced by nuclear explosions, and the opportunities for defense suppression, it would seem to be a distant goal for ATBM systems to meaningfully function against a massive employment of Soviet nuclear armed TBMs. The Soviets already have several thousand nuclear armed TBMs and would be well ahead in any offensive-defense, theater arms race. This threat is of course not new. Soviet nuclear armed TBMs have threatened NATO for many years and the threat of retaliation has been an adequate means thus far for deterring initial Soviet use. Conclusion of an arms control agreement banning such weapons would also eliminate the need for defending against these missiles, although missiles of under 500 km range will apparently not be affected by any imminent agreement.

There has been increased interest in using ATBMs to increase Soviet uncertainty in implementing limited nuclear options. This has resulted from concern that the Soviets could use improved accuracies to significantly reduce warhead yield requirements. Historical trends in accuracy and yield loosely support this argument.[1] Gormley argues that 70 percent of the NATO target base might be attacked with subkiloton yields if the Soviets obtain high accuracy. This would greatly reduce the predictable collateral damage and might encourage the Soviets to think about initial and limited nuclear use, and has motivated interest in examining how ATBM might help deter such attacks. It also introduces the possibility that ATBM might be justified by a combination of nuclear and conventional missions.

Conditions For Justifying ATBMs

Despite the potential new capability, there would seem to be many conditions to be met before ATBM should be considered as a means of deterring such attacks. First, one must convincingly argue that limited options are an important part of Soviet nuclear strategy. Clearly, one aspect of Soviet nuclear strategy is to deter initial NATO nuclear use by the threat of a massive nuclear response. Arguments about Soviet limited options are less widely accepted. One must secondly argue that TBMs play a critical role in any limited options, a role that cannot be replaced by the large variety of other delivery mechanisms available to the Soviets. Third, one must somehow argue that the Soviets would not simply overwhelm the uncertainties induced by defenses. It is not obvious, given highly accurate missiles, that saturating particular aimpoints greatly increases the predictable collateral damage. Fourth, one must show that a NATO nuclear response is not an adequate deterrent. Fifth, one must show that taking actions to counter scenarios satisfying the first four conditions has a higher priority than other NATO needs.

Some Scenarios

Despite this tightly bound set of conditions, there have been attempts to describe scenarios that fulfill the above criteria, with the exception of the third. Blair and Chow argue in one such scenario[2]

---

[1]See, for example, S. Meyer, *Soviet Theatre Nuclear Forces Part II: Capabilities and Implications*, the International Institute for Strategic Studies, Adelphi Paper 188, London, p. 57.

[2]D. Blair and B. Chow, "European Ballistic Missile Defenses—Reducing the Danger of War," in D. Quayle (ed.), *Strategic Defense and the Western Alliance*, Significant Issue Series, Vol. VI, No. 6, The Center for Strategic and International Studies, Georgetown University, 1986.

that the Warsaw Pact has a 400–350 advantage in General Purpose Forces (GPFs) prior to a war. Given a six hour lead time in dispersal, only 150 of the Soviet's 400 units would be vulnerable, whereas 300 of NATO's 350 would remain undispersed. The Soviets could then launch a surprise nuclear TBM strike involving several hundred low-yield nuclear weapons.[3] Even if NATO's sea-based deterrent could be used, the Soviets would still emerge with a 250–50 advantage in GPFs after the initial exchange. The authors thus argue that NATO is more vulnerable than the Warsaw Pact to a surprise nuclear exchange. ATBMs deployed by both sides would have a stabilizing influence since NATO's more vulnerable assets benefit more from protection. Soviet assets would not benefit as significantly from ATBMs since their dispersal lead time has already reduced their vulnerability.

The quantitative results presented in the above scenario are not surprising. The credibility of the threat, however, and the conclusion that a NATO nuclear response is an inadequate deterrent is in the authors' judgment far more questionable. The scenario assumes that the Soviet incentive for such an attack is the resulting advantage in general-purpose forces. But the balance of general-purpose forces would seem to be of little consequence after the exchange of several hundred nuclear weapons. It is highly questionable that both sides would again resume a conventional conflict after such an exchange. Far more likely is continued nuclear use, continued increases in collateral damage, and general nuclear war in Europe. Indeed, any doubts about NATO's determination to meet subsequent advances of Warsaw Pact conventional forces with nuclear weapons will have been eliminated. The supposed Soviet motive—an advantage in conventional weaponry—would seem to be of little consequence given the high probability that large numbers of nuclear weapons would subsequently be used. The level of risk would seem to outweigh any battlefield advantage that might be gained.

Nor can the assumption of limited collateral damage and hence a highly reasoned NATO response be taken by the Soviets without question. For low-yield weapons (below 5 kT and in many cases below 1 kT), primary blast and thermal effects will be restricted to regions on or very close to the military targets. Such an attack might still produce large numbers of instantaneous military casualties. They may also cause secondary effects in regions beyond the military targets, including fires, incidents of flash blindness, and deposit of radiation (either from ground bursts or from radiation washout by rain from air

[3]The word "hundreds" does not appear in the article, but given the number of targets involved, the number cannot be significantly lower.

bursts). Such effects would not necessarily mean large numbers of prompt civilian deaths, but their impact on a NATO leadership trying to make fast decisions in a highly confused, never previously experienced situation is totally unpredictable. Nor will NATO leaders know the precise yields used or the accuracy with which they were delivered. The Soviets themselves could not be sure that a small number of weapons would not be significantly off course and land in a heavily populated area. There are thus a range of reasons for the Soviets to believe that NATO's response will not be structured by collateral damage calculations made before an attack. For reasons of war controllability, and the basic psychological reasons that have allowed deterrence to work, the risks for the Soviets in implementing such an attack seem high. The threat of a NATO nuclear response would seem to be an adequate deterrent to this scenario.

A variation of this argument might involve significantly fewer numbers of nuclear weapons. One might imagine a small number (for example, fewer than 20) of low-yield nuclear weapons as part of an otherwise conventional attack. Nuclear armed TBMs might be used to strike essential time-critical targets located in the rear area that could not be destroyed by conventional means. Such targets might include runways at MOBs, or key command and control centers for coordinating air defenses. It might then be very difficult for NATO to find an equal number of targets whose destruction had the same impact on the initial conventional thrust.

Despite this difficulty, the threat of retaliation would still seem to be credible. Arguments related to the preceding scenario regarding war controllability and the rationality of a NATO response would also have some relevance here. NATO would have a number of credible limited responses. Although it might be difficult to find an equal number of targets that would have a precisely counterbalancing effect on the initial conventional assault, there is little doubt that NATO could find an equal number of important Warsaw Pact military targets to respond against. Nor could the Warsaw Pact assume that the response would consist of the same number and yield of weapons used. NATO could choose to respond with enough weapons to have an equal effect on the initial conventional battle, rather than attempt to equalize yield. The Soviets would then find themselves in a situation of having not achieved a conventional advantage and having eliminated any NATO self-doubts about crossing the nuclear threshold in response to forthcoming Soviet conventional advances. Thus the range of second-strike options would be a credible deterrent to a limited Soviet initial use.

Dual Conventional and Nuclear Use: An Additional Rationale?

Finally it might be argued that to the extent ATBMs do help deter limited options, its dual nuclear and conventional role increases the rationale for development. There are, however, technical reasons to be skeptical about the dual use argument. Although incoming conventional and nuclear warheads cannot be distinguished, engineering requirements for the defense are not similar. Operation of ATBMs in a nuclear environment implies vastly different requirements on the sensors and communication links. Depending on the assumed weapon yield and target hardness, intercept altitudes may differ. Since the target base vulnerable to nuclear attacks is much larger, there will be correspondingly different area coverage requirements. An ATBM designed to meet NATO's conventional needs would help deter nuclear options only in the most narrow and constrained cases.

It might still be argued that an ATBM designed for defense against conventional missiles could induce some minimal uncertainty in a nuclear scenario and thus provide a basis for the evolutionary development of a more extensive antinuclear capability. However, it is the surveillance sensors and communication links that must be changed to operate in a nuclear environment, and unfortunately, these are the most expensive portions of existing systems and the least likely to be changed. There may be little opportunity for evolutionary improvement in these systems. In looking at an ATBM for conventional defense, NATO should avoid expensive upgrades in other components, such as interceptors. Such upgrades might siphon away large amounts of money, significant when compared with the pool of funds for air defense, but insignificant compared with the cost of nuclear defense.

V. THE ROLE OF NATO-ATBM AND THE RELATION TO SDI

ATBMS IN THE THEATER

To this point we have considered the role of ATBMs in the context of existing theater strategy. Highly accurate conventionally armed TBMs will provide the Soviets with a new range of capabilities, but there will also be technical and operational limitations. These limitations will probably restrict the use of first-generation conventional TBMs to strictly air defense related targets. Most threatened are airbases. Passive defenses will initially be cheaper than ATBM, and can simultaneously counter the aircraft threat. There are identifiable limitations to passive techniques and ATBM deployment could eventually be needed as a supplement. In the nuclear area, improved TBM accuracy will not in obvious ways undermine the credibility of a NATO nuclear response as a deterrent to any initial Soviet use of nuclear weapons. In both the conventional and nuclear areas, there is in the authors' judgment little urgent need to deploy ATBMs for NATO's military needs.

A NATO-ATBM Research Program

Although passive defense measures have initial priority, ATBMs cannot be excluded as a potential longer term option for airbase defense. If needed, NATO would obviously prefer a system with the greatest range of capabilities and highest performance. The disadvantage is increased costs and technical risks. It is undoubtedly logical to constrain a research program to be consistent with NATO's military needs. The limited target set that might need protection with active defenses suggests there is little advantage to ATBM architectures that might protect a significant fraction of Western Europe over architectures intended to protect just these targets. A capability to counter nuclear threats is also not required. NATO's general situation also implies that few technical risks need to be taken to meet the threats posed by Soviet TBMs for at least the next decade. The threat has not yet appeared, passive defenses provide a hedge, and there is no need for urgent ATBM deployment to overcome gaps in NATO preparedness. Conclusion of an arms control agreement on intermediate range missiles would further reduce the need for an urgent response. The

authors conclude that ATBMs may be developed in an evolutionary manner, thereby maximizing the probability that some demonstrated capability might be available in the 1990s.

A modest research program might be built largely on traditional ground-based radar and interceptor technologies. Excluding the need to defend against the nuclear threat eliminates the need to cope with a disturbed environment and implies that mobility, and an associated self-defense capability, may be adequate to insure the survivability of the defenses themselves. Severely hardened defenses and air- or space-based components are probably unnecessary. Excluding the nuclear threat also allows for low intercept altitudes, and when combined with the small area coverage requirements, ensures that mobility can be easily obtained. The Patriot system is, for example, mobile and has sufficient radar size and interceptor speed to provide intercepts at militarily useful distances. The SA-90 antimissile, antiair system being developed in France provides another example. Although these systems are not necessarily the optimal choice, they indicate that the first steps in ATBM development can be based on traditional technologies. The focus of NATO research should thus be on technology integration, so that a working ATBM prototype can be built, and the costs and performance better understood.

A Higher Risk Alternative

A second NATO option might accept more technical risk in the hope of obtaining a highly efficient ATBM capability. Such a capability would probably involve intercepting incoming missiles at greater distances from the defense so that a multilayer defense might be constructed.[1] The corresponding technical and economic penalties are perhaps best illustrated by the need to increase radar peak power by the fourth power (in the mathematical sense) to obtain a linear increase in radar detection range, which is a prerequisite for early intercept. Greater intercept distances suggest in turn significantly larger system costs, size, and vulnerability. There is, of course, the hope that the range problem might be reduced by surveillance information from an Airborne Optical Adjunct (AOA) system. This option, however, calls for solution of a very demanding command and control problem and dependence on unproven technology. Even under optimistic assumptions, the AOA itself could cost between $8 and $20

---

[1]Multilayer in the sense of layers within what is often categorized as the terminal layer in the context of defense against ICBMs.

billion for implementation in the theater.[2] Even if technical risks are overcome, a higher performance system means correspondingly higher deployment costs. In terms of a research program, a multilayer system implies that scarce research dollars will have to be divided among the layers. Although there may be elements of commonality, intercepts at different altitudes will require different interceptors, different homing mechanisms, and some different surveillance assets. If research dollars are scarce, such an approach would suggest that NATO must gamble on a sophisticated ATBM to overcome serious deficiencies. Recall, however, that ATBMs might best be thought of as a supplement to passive defenses, which provide a hedge against a threat as yet unseen. Evolutionary development is acceptable, and it would be beneficial to have a demonstrated ATBM capability in the 1990s, should it be needed. These would seem to be strong arguments for NATO to concentrate its initial research efforts on only the lowest and technically simplest layer of the defense.

SDI TECHNOLOGIES AND NATO-ATBM RESEARCH OPTIONS

As part of its charter, the SDI program office is engaged in studying the protection of Europe from tactical ballistic missiles, although much of its work has concerned large nuclear threats. There has been less formal work dealing with how SDI technologies might contribute to near-term goals, and to our knowledge no formal positions on how a near-term ATBM might support SDI technology development. The technologies being pursued in SDI, and some of the technical problems involved in developing strategic defenses do provide some general answers.

Many of the space-based technologies being pursued in the SDI program would provide only limited capability against the Soviet SS-20 and would not be relevant to shorter range TBMs. Other SDI programs, on the other hand, if successful would provide some capability against shorter range missiles. The Airborne Optical Adjunct system could provide early surveillance information, allowing ground-based radars to be cued (reducing their search volume and using the corresponding power savings to integrate pulses), thereby extending their range. This would allow intercepts at greater distances from the defense and would form the basis of a multilayer defense. The highest

---

[2] T. Gold, "Theater Ballistic Missile Defense Architectures," draft report presented at the European American Institute for Security Research Workshop on NATO Theater Ballistic Missile Defense, October 9–11, 1986.

intercepts might be achieved by the Exoatmospheric Reentry Vehicle Interceptor System (ERIS), the next layer with the High Endoatmospheric Interceptor (HEDI), both being developed within SDI. The bottom most layers might remain based on traditional technologies as discussed above. The system might also be supported by a fast-scanning space-based boost-phase surveillance sensor under study in SDI. It could give the AOA initial surveillance data on launches of the SS-12, SS-20, and SS-23.

The use of SDI technologies could thus provide the basis for a robust multilayer defense against conventionally armed TBMs. Some SDI technologies would be included in the more ambitious research option highlighted above, but ambitious SDI goals, such as using components intended to survive and operate in a nuclear burst environment, probably would exceed NATO requirements. Since NATO does not require deployment in the foreseeable future, even the ambitious research option would do no more than duplicate research already occurring within SDI. The smaller program is not heavily dependent on SDI system technologies.[3] Although any missile defense may benefit from basic research being pursued within SDI, the system technologies under study in SDI will have little direct connection with a "bottom-up" approach to satisfying NATO's needs.

[3]Traditional technologies that were previously considered part of the Army's ATBM research, such as FLAGE (Flexible Lightweight Agile Guided Experiment), and are now organizationally part of the SDI program, would of course be relevant to even the limited research program.

VI. ATBM POLITICS IN THE FEDERAL REPUBLIC OF GERMANY[1]

ATBM POLITICS AND ATBM POLICY OPTIONS

As discussed at the beginning of this report, the role of ATBMs in NATO's military strategy is now only part of the ATBM debate. SDI and associated political issues will for some increase and for others decrease the rationale for ATBM. Our estimate of NATO needs indicates two policy options: (1) a limited research program using traditional technologies and (2) a more ambitious research program incorporating some SDI technologies, more technical risks, and offering the possibility of higher performance. The second program involves only research and those interested in an early demonstration of SDI technologies might want to consider a third option: (3) an accelerated program emphasizing deployment, greater use of SDI technologies, and justified by a combination of NATO and SDI needs. Finally, those who see the political issues associated with ATBM as leading to unacceptable problems would want to consider a fourth option: (4) abandonment of ATBM.

If any of the above options is to be pursued, it must be politically acceptable in the Federal Republic of Germany (FRG), where ATBMs will be deployed. Assuming widespread support in the FRG for meeting NATO's military needs, when those needs are not identified with SDI, three general questions must be asked about SDI:

1. To what extent will SDI and related issues increase support for ATBM?
2. To what extent will they decrease support?
3. To what extent do the answers depend on the ATBM option and goal being considered?

Since an accelerated program (option 3) goes beyond NATO's near-term needs, SDI-related issues must generate additional support and negative associations will have to be rejected or largely ignored. The programs meeting NATO's needs involve only research, but should deployment be desired, acceptability would become an issue. Support

[1]This section is based on interviews conducted in the FRG during 1986. During the year we interviewed defense spokesmen for the five major political parties, representatives from the various branches of the government, researchers in the major defense policy institutes, academics, and journalists.

for meeting NATO's needs will have to outweigh objections that SDI might arouse. Of particular importance to policymakers is the potential differences between the limited and accelerated programs (options 1 and 2) in this regard. Finally, should none of the programs appear to be free from manageable controversy, policymakers may have to consider the military penalties implied by abandoning ATBM (option 4).

In this section we attempt to provide preliminary answers to these three general questions and apply the answers to the ATBM options listed above. Since the ATBM debate is still preliminary, with most deployment options at least many years away, such an assessment might seem premature.[2] However, it is no more premature than an analysis of NATO's military ATBM needs. Estimating the military implications of conventionally armed Soviet TBMs also involves analyzing issues dominated by uncertainty and subject to change from factors not directly related to the issue. In developing long-term policies we have no choice but to base assessments on current information, estimate how things may evolve, and modify policies as information becomes available. We will try to assess how today's political attitudes may affect ATBM options, so that we have a basis for long-term planning and a starting point for modifying results.

SDI IN THE FRG

Most of the political issues now associated with ATBM are directly or indirectly related to SDI. European and German reactions to SDI have been documented elsewhere and we will not attempt to duplicate such accounts here.[3] The following discussion merely provides a short summary of the SDI debate as it now stands, so that we can better understand similarities and differences with a potential ATBM debate.

SDI emerged as a major security policy issue in the FRG after announcement of the program. Since that time the intensity of the debate has diminished. Widespread concerns about the decoupling of U.S. and European defense considerations, new instabilities, and a new arms race still exist, but they are discussed less frequently as awareness of the long-term nature of the program grows. This trend was underscored by the Challenger catastrophe, which provided a graphic demonstration of how difficult space operations could be. Unlike the Pershing II debate, the SDI debate does not now involve the near-term deployment of systems on German soil. Also different are relative

[2]The exception is a modest upgrade to the Patriot air defense system.

[3]For an account of the German debate, see E. Pond, "The Security Debate in West Germany," *Survival*, July/August 1986.

positions of the government and the opposition. The government has not unconditionally supported SDI. Support is based on SDI being a legitimate response to Soviet ABM research. Having placed SDI in the context of existing military strategy, the government has obtained agreement among the disparate elements of the existing coalition government and reduced the intensity of opposition arguments.

We do not imply that SDI is unimportant or ignored. The political parties have carefully stated positions, the issue has been widely discussed, and those supporting and opposing the program are well known. General public reaction seems to be negative, although an important element of the existing CDU/CSU/FDP coalition could support SDI strongly.[4] A recent public opinion poll verified this discrepancy between the government and the electorate by showing that 54 percent of electorate opposed SDI, only 22 percent supported it, and 24 percent had no opinion. Among CDU and CSU voters the tally was evenly split.[5] Support for SDI within the governing coalition is strongest in the CSU, which has enthusiastically supported SDI. Similar views are held among many CDU members. However, enthusiasm in the CDU is not unanimous, and the FDP generally opposes the rationale behind SDI, as do the two opposition parties. These attitudes probably reflect a majority of the electorate, as indicated by the above referenced poll. The Chancellor has at times seemed enthusiastic about SDI but has maintained a cautious policy reflecting the divisions in his government and the overall attitude of the electorate. Enthusiastic support from the government would also seem to some to be inconsistent with the publicly stated preference for arms control solutions to military problems. Those in the government with a more positive attitude toward SDI have either been unsuccessful in forcing a more aggressive policy or have been uninterested in doing so.

SDI ISSUES INCREASING SUPPORT FOR ATBMS

Military Issues and the Ministry of Defense

A simple translation of the SDI debate implies that SDI might increase the rationale for ATBMs to an important part of the governing coalition, but that the government as a whole would remain divided, cautious, and unwilling to make SDI-related arguments to the

[4]Christian Democratic Union (CDU), Christian Social Union (CSU), Free Democratic Party (FDP).

[5]*Der Spiegel*, November 24, 1986, pp. 44 and 45.

electorate. Thus, if SDI issues are to create significant new support for ATBMs they must have a stronger appeal when discussed in the context of an ATBM program. Such support is suggested in some of the public statements of the defense minister, Dr. Woerner.[6] Although Dr. Woerner might be termed a moderate SDI supporter, he seems enthusiastic about ATBMs. The enthusiasm seems to be based on a combination of SDI issues and NATO's military needs. For example, in referring to conventionally armed TBMs in *Strategic Review*, Dr. Woerner wrote:[7]

> The urgent and practical answer to this threat is an antimissile defense for NATO Europe.

The sentence was highlighted in the summary of the article despite a later acknowledgment that passive defenses may be an alternative. Dr. Woerner has also argued that SDI-related issues provide a basis for supporting ATBMs. In his March 1, 1986 speech at the Internationale Wehrkundetagung in Munich, he seemed to suggest that the discrepancy between nuclear and nonnuclear nations might in the long run be reduced by the development of strategic defenses. He presented ATBMs as means of keeping Europe up to date with this new strategic trend. While not specifically supporting strategic defense, he seemed to be arguing that its inevitability increases the need to proceed with ATBMs.

Despite the Minister's apparent enthusiasm, support for ATBMs is not the official policy of the German Ministry of Defense. The Ministry officially favors NATO evaluation of the problem and a determination based on NATO's needs. This may reflect a change in the Minister's thinking or may be evidence of the relative importance of ATBMs in comparison with other defense issues. There is little flexibility in the German military budget for high-technology research programs like ATBMs. The increasing costs for dealing with the emerging manpower problem in the Bundeswehr will reduce flexibility even further. Funds for an ATBM program must come from other sources and would inevitably cause program rivalries. There also seems to be significant disagreement at the lower levels of the MOD about the Minister's attempts to identify active defenses as a preferred solution. All of this is evidenced by the growing tendency in the Ministry to consider answers to the TBM threat only in terms of NATO's overall air defense architecture.

---

[6]Dr. Woerner is now expected to leave his post in the defense ministry in order to become NATO General Secretary.

[7]M. Woerner, op. cit.

Another SDI-related military issue that could increase support for ATBMs is the possibility that ATBM development might reassure Europeans that SDI will not decouple the United States and Europe. However, concern about decoupling has faded as the difficulties in implementing a space-based defense have become clearer. Supporters of SDI still point to this issue as indicating the need to deploy ATBMs in Europe. Those opposed to SDI seem unconvinced that this will solve the problem.

Technological and Industrial Interest

SDI has at times been hailed as an important program for its contribution to technological progress alone. This has heightened European anxieties concerning the status of European high technology and has created interest in a European response to SDI. An ATBM program could represent such a response and might also create a means for encouraging the United States to share SDI research findings. These technology development issues are clearly an important component of CSU support for European missile defense.[8] The CSU represents Bavaria, the center of the German aerospace industry. This argument is, however, likely to produce few supporters of ATBMs who do not already support SDI. There is now less feeling that Europe must respond to the technological challenge presented by SDI, particularly in Germany, where greater confidence in the economy has diminished concerns about the status of German high technology. Enthusiasm for SDI as an important source of new civilian technologies has also diminished. Two well-publicized studies from very different organizations both concluded that the civilian spin-offs from SDI will be few.[9] Research Minister Riesenhueber has been skeptical as well, and stated that technology development is no reason for participation in SDI. Our conversations in the research ministry indicate this would apply to ATBMs as well. In addition, the ATBM issue has arisen at a time when the U.S. government has increasingly restricted the flow of technologies to Europe. This development has been well publicized and there is widespread doubt about gaining access to American military technologies.

[8]The reasons for CSU support for SDI, including the technology development rationale, are stated in *Bericht der SDI-Komission*, Landesvorstand der CSU, November 4, 1985.

[9]B. Kubbig, *Zivilen Nutzen schaffen mit Raketenabwehrwaffen?*, Hessischen Stiftung Friedens und Konfliktforschung (HSFK). The other study was compiled by the Industiean-Betriebsgesellschaft (IABG). HSFK is a security policy institute which tends to be critical of government defense policies, whereas IABG is a government-funded military operations research institute.

Nonetheless, there is continuing German interest in European high technology cooperation and ATBMs would in theory seem to be an appropriate topic for such research. This continuing interest was evidenced by the unusual coalition developed between the usually combative foreign minister, Mr. Genscher (FDP), and the minister president of Bavaria, F. J. Strauss (CSU), in supporting German participation in the Hermes program.[10] Strauss saw Hermes as a means of advancing the Bavarian aerospace industry, while Genscher saw it as a symbol of greater European cooperation. The German government may also support the Columbus space station, and Ariane V. These projects also indicate, however, that Germany neither needs nor can afford new efforts of a similar character. The research minister and the finance minister have already been highly critical of the costs implied by these programs. The research ministry already spends one billion marks annually on space technology and these programs might double or triple the figure.[11] Questions are being raised about the lack of practical applications associated with the programs.[12] An ATBM effort based on a similar rationale will inevitably raise further questions of a similar character. Thus, despite the attractiveness of international technology cooperation, there is no significant need or desire to develop ATBMs on such a basis. Of course, German interest might be stimulated if the United States were to supply significant funds directly to German industry; however, there is little indication this will occur.

Attitudes within the Government

Despite the apparent enthusiasm of the German defense minister, there is little reason to expect that SDI-related issues will increase support for ATBMs beyond the minority that is already enthusiastic about SDI. The government could undoubtedly support an ATBM program designed to match NATO's stated military needs. However, supporters of an accelerated program intended to partially support SDI can at best hope for a cautious government policy, similar to that developed for SDI. There is already evidence for this. Initial government thoughts on ATBMs do indicate some broad issues of political concern (discussed in the next section) and there is little enthusiasm for ATBMs

---

[10]Hermes is a proposed reusable manned space vehicle that is to be developed by a consortium of European nations.

[11]Annual costs of two billion marks were relayed to us in private communications from the research ministry; the higher figure is from *Sueddeutsche Zeitung*, November 26, 1986, p. 4.

[12]For a typical example, see M. Birnbaum, "Ungewisse Starts," Sueddeutsche Zeitung, October 2, 1986.

as political issue. A recent *Spiegel* article describes the defense minister as wanting to make ATBMs a campaign issue in last year's election, but overridden by the Chancellor and the CDU campaign organization, which believes that the average CDU voter is hesitant about "intensified armament."[13] This view was confirmed by the strong showing of the FDP in the recent election, which was viewed by many as a reaction to a perceived hardening of CDU/CSU positions on defense policy. The basic attitudes of the German populace were also revealed in a recent public opinion poll, which showed that more than 90 percent of the German people favor acceptance of the zero-zero arms control option.[14] Thus, the cautious government position taken in apparent contradiction to that of the defense minister can be well understood, given the unlikelihood that ATBMs will create new support and the possibility, as will be discussed in the next section, that it could be a source of controversy.

ISSUES REDUCING SUPPORT FOR ATBMS

A simple translation of the SDI debate would also suggest that SDI-related issues have significant potential to undermine support for ATBMs. Objections could be even more intense since ATBMs may offer the potential for near-term deployment. The debate is still preliminary. Its intensity will depend on the extent to which SDI issues are actually linked to ATBMs and the extent to which support for meeting NATO's needs brakes this opposition.

Issues Raised within the Government

In trying to anticipate the scope of an emerging debate, one is tempted to emphasize the arguments of critics and to determine the appeal of these arguments to broader constituencies. This is undoubtedly an important part of the debate in the FRG. But it should be remembered that although the current government has not been strongly swayed by political arguments to support ATBMs, it has not voiced major philosophical problems. A few questions have, however, been raised in internal discussions. Most often discussed is the relationship between ATBMs and the ABM treaty. The ABM treaty is seen as the cornerstone of détente in a country where hopes for progress in arms control and east-west cooperation span the political

---

[13]*Der Spiegel*, September 1, 1986, pp. 28, 31.

[14]*Politbarometer Mai 1987*, Institut fur Wahlanalysen und Gesellschaft Beobachtung, Mannheim.

spectrum. Concerns about the ABM treaty have no doubt been intensified by fears that SDI will damage the treaty. ATBMs could not be supported in the Federal Republic if they were perceived to contribute to this process.

The FRG has not formulated a specific interpretation of how ATBMs might affect the ABM treaty. None of the coalition partners has voiced overriding concerns. It is likely that the current government would see some ATBM development as being consistent with the treaty. Preliminary governmental misgiving centers around Article IX, which prohibits the transfer of ABM components to third parties. This article, coupled with the inherent ambiguity between ABM and ATBM systems, could potentially be seen by members of the government coalition as prohibiting the use of SDI technologies in an ATBM program. The government could ultimately come to view the relevant technologies as not constituting ABM "components," although officials have voiced fears that such a policy will be difficult to explain, particularly if there is an organizational connection to SDI.[15]

Additional misgivings have been expressed by liberal FDP members of the coalition. The FDP may view the use of ATBMs for intercepting nuclear armed threats with greater skepticism than a defense against conventionally armed missiles. Any defense intended to intercept nuclear armed missiles will by necessity raise questions about nuclear doctrine and many in the FDP, and perhaps some in the other coalition parties, would be anxious to avoid such a new debate. This is an issue that has been debated in the Alliance since the earliest considerations of ABM and it is not surprising that it would be the source of some concerns.[16] The FDP has also voiced misgivings about SDI, perhaps best witnessed by their opposition to any sign of political support for SDI in the recent German-American SDI cooperation agreement. Any potential organizational connection between SDI and ATBMs, or any attempts to use an ATBM program as an SDI "test bed," might be strongly opposed by the FDP. The importance of such FDP opposition was underscored by the federal elections in January 1987. The FDP increased its share of the vote, enabling Foreign Minister Genscher to increase his influence in security policy at the expense of the more pro-SDI CSU.

---

[15]In defining ABM components, the German government has so far agreed with the U.S. position that certain planned tests within the SDI program are tests only of subcomponents and are therefore not affected by the ABM treaty.

[16]European thinking on this subject is discussed in more detail in D. Yost, "Ballistic Missile Defense and the Atlantic Alliance," *International Security*, Vol. 7, No. 2, Fall 1982, p. 143.

Issues Raised by the Opposition

The opposition, as represented by the SPD (Social Democratic Party) and the Green party, would confirm any of the political concerns being discussed within the government and would express them in even stronger terms. The harshest critics, e.g., some in the Green party, argue that a TBM trajectory is similar enough to a short-range SLBM (sea-launched ballistic missile) trajectory to ensure that any ATBM system is also ABM capable. Thus U.S. participation in an ATBM program would be a violation of the ABM treaty and a European program would violate the spirit of the treaty. More moderate critics argue that highly capable ATBM systems which could intercept the longer range TBMs are susceptible to ambiguity and would therefore have an uncertain relationship to the treaty.[17]

Other SDI-related issues have also been linked to ATBMs. Some SPD members doubt the credibility of the TBM threat and see ATBMs as a cover for European participation in SDI.[18] An organizational link between SDI and ATBM will strengthen this argument, as would any technological benefits that might flow from NATO to the SDI program.

The lack of a carefully defined military role for ATBMs has enlarged the scope of the debate. For example, some in the SPD have argued that ATBMs are intended to protect Pershing II and GLCM (ground-launched cruise missile), thereby cementing their deployment. (Of course, one would expect such arguments to disappear if the current arms control negotiations reach a successful conclusion.) Similar arguments have been made about protection of FOFA (follow-on forces attack) units both by the SPD and in a well-publicized study by an ATBM supporter.[19] Potential protection of interdiction forces gives rise to visions of a NATO first-strike capability. Although such a possibility may seem improbable to NATO planners familiar with the details of NATO interdiction capabilities, it is an issue that touches an extremely sensitive point in the German defense debate.

---

[17]See, for example, T. R. Kappen and H. J. Schmidt, "SDI, Taktische Raketenabwehrsysteme und die Bundesrepublik," *Friedensforchung Aktuell*, Hessische Stiftung Friedens und Konflictfourschung, Frankfurt, Ausgabe 12, Summer 1985.

[18]See K. Fuchs, MdB, "Europaeische Verteidigungsinitiative: Einsteig in SDI," *Sicherheit und Frieden*, Jahrgang 4, Heft 1, 1986.

[19]For SPD views, see E. Horn, MdB, "Es ist nur ein europaeischer Ableger des SDI Projeckts," (It is only a European extension of the SDI project), *Frankfurter Rundschau*, April 5, 1986, or K. Fuchs, *ibid.* The study by the ATBM supporter is T. Enders, *Missile Defense as a Part of an Extended NATO Air Defense*, The Konrad Adenauer Stiftung, May 1986, p. 54. The Konrad Adenauer Stiftung has close but unofficial ties with the largest partner in the government coalition, the Christian Democratic Union.

THE ATBM DEBATE AND PROGRAM OPTIONS

The ATBM debate is only beginning and the importance of these arguments cannot at this time be known. We can say that SDI has politicized the issue of ATBMs and extended air defense and linked it with other controversial issues. The German government has raised some questions, but most criticism has been voiced by critics of the current government or of NATO strategy. Still, issues related to SDI, FOFA, intermediate-range nuclear forces (INF), and the ABM treaty will be of concern to the majority of Germans.

SDI issues will be applied to the ATBM debate and they will, to an unknown extent, undermine support for ATBMs. The obvious counterbalancing factor is support for meeting NATO's military needs, and in particular air defense needs. Although NATO issues which have been included in the ATBM debate, such as INF and FOFA, are controversial, there has been almost no criticism of the role of ATBMs in extended air defense. In fact, there is a broad consensus for air defense in the FRG. Despite opposition to INF and other NATO policies, the opposition SPD supports air defense and has made it a symbol of their commitment to conventional defense in Europe. The political acceptability of ATBMs may depend on how those supporting air defense, but opposing SDI, balance these competing factors.

SPD policy, although not representative of the entire constituency, does indicate that SDI considerations can outweigh air defense factors. While supporting air defense, including defense against cruise missiles and stand-off weapons,[20] the SPD opposes ATBMs. This seemingly inconsistent position has been attacked by the Defense Minister, who has argued that a credible air defense cannot be built by defending against some trajectory types and not others.[21] The SPD has responded by citing those aspects of Dr. Woerner's speeches which they feel imply a role for ATBMs in connection with SDI, INF, or FOFA.[22]

SPD attitudes illustrate that opposition to ATBMs can occur from some who support air defense. However, the discussion to this point has been based more on the defense minister's comments than on specific concepts. Opposition to ATBMs incorporates many viewpoints as to their purpose. The defense minister went to great pains in *Strategic Review* to describe ATBMs as a NATO program, but many feel his other statements contradict this. The role of ATBMs in an SDI

[20]See, for example, *Europaeische Verteidigungsinitiative zur Abwehr ballistischer Raketen*, SPD Budestagfaktion, Bundestag paper 10/4440, December 4, 1985.

[21]See Dr. Woerner's Bundestag testimony, December 13, 1985, p. 14102; also, fn. 21.

[22]Dr. Woerner's March 1, 1986 speech at the Internationale Wehrkundetagung is often criticized in this context.

type population defense adds to the confusion. Until specific ATBM concepts with specific goals emerge, the debate is likely to remain confused and arguments against ATBMs can be drawn from the wide variety of missions they might fulfill.

What is perhaps more important is what the current debate implies about an ATBM debate after specific concepts are introduced. Concepts going beyond NATO's needs, with the purpose of advancing SDI-related goals, will obviously cause the greatest difficulty. Such concepts would incorporate the widest range of military capabilities and the widest range of criticisms. A public understanding that such a system also serves NATO needs would be hard to create. Thus, such an option may imply significant opposition from the constituency that supports air defense but opposes SDI. Concepts tightly bound to NATO's needs, and separated from SDI goals, would seem to be less susceptible to these problems.

The debate also brings out differences among the various approaches to meeting NATO's needs. The more ambitious option described in the previous section incorporated SDI technologies and thus suggests an organizational connection to SDI. The more conservative option was based on traditional technologies and therefore could be more effectively separated from SDI. European manufacturers of air defense systems have demonstrated these technologies and the program could be largely European, minimizing concerns related to Article IX of the ABM treaty. This type of ATBM system would be capable only of intercepting TBMs at limited distances from the target. This would minimize the ABM ambiguity problem, since it could neither intercept strategic missiles at sufficient distances from targets to negate a nuclear weapon, nor function in the resultant environment. Systems capable of intercepting TBMs at large distances from the defense could intercept strategic missiles over correspondingly smaller, but nonetheless significant distances. An ambitious ATBM option may also be construed as defense of INF or FOFA forces. Even if it is intended only to protect an air defense target, the longer intercept distance implies an area defense capability. Attaching a point defense to every INF or FOFA asset is not a practical way to provide active defense for these targets. Defenses with limited reach can be better tailored to protecting that set of air defense targets most threatened by TBMs without having to include more controversial and less vulnerable aimpoints. Thus the limited approach seems to stand outside the negative political arguments and can be more easily bound to satisfying air defense needs, which is widely supported in the FRG.

This argument suggests that limited ATBM options offer the greatest opportunity for removing the political dimension from the

ATBM issue. However, the connection between ATBMs and SDI cannot be completely erased and political issues will now be associated with ATBMs in any situation. Although SDI has magnified concerns about the ABM treaty, concerns about Article IX and Article VI originate with ambiguities in the treaty and not with SDI. Thus, even constrained approaches to ATBMs, such as Patriot upgrades, will encounter political criticism.[23] Tightly limiting ATBM options to air defense may, however, minimize the credibility and level of support for such arguments. Nonetheless, ATBMs have become the subject of attention and even if the political aspects are minimized, critics will be quick to attack ATBM potential cost effectiveness, and the validity of the threat it is intended to counter. Such questions might fulfill an important role in the ATBM debate.

---

[23]See W. Bartels, *PATRIOT Eine Rakete, die uns teuer zu stehen kommt*, Die Friedensliste, Bonn.

VII. CONCLUSIONS

NATO'S NEEDS AND THE RELATIONSHIP TO SDI

The possibility that ATBMs could simultaneously serve NATO's military needs and advance the SDI program has been a major factor in drawing attention to this issue. The potentially improved accuracy of Soviet TBMs in the 1990s is the potential basis for NATO's needs. However, improved accuracy may not imply important new dimensions to the nuclear threat, and technical and operational uncertainties may constrain the scope of the conventional threat. The first generation of conventionally armed TBMs might only threaten fixed, soft, and highly time-critical targets. This suggests that NATO's TBM problem in the 1990s may be largely a problem of airbase defense. Numerous passive defense techniques can be employed, should initially be cheaper than ATBMs, and also counter the aircraft threat, which should remain the major component of the air threat in the 1990s. Passive defenses do have definable limitations and ATBMs may eventually be needed to supplement these techniques.

We thus see little near-term connection between NATO's ATBM needs and SDI. The limited number and type of targets threatened by TBMs, coupled with passive defenses, narrows both the urgency for ATBM deployment and the types of systems that are relevant. ATBM is not needed to overcome gaps in NATO preparedness. A crash program or significant rearrangement of priorities would seem inappropriate. We thus see an evolutionary research program as best meeting NATO needs. Such a program would emphasize intercepts at minimum useful distances from the defense and could be based on traditional technologies. It would maximize the probability of having some demonstrated capability in the 1990s, should it be needed. A more ambitious research program, emphasizing a multilayer defense, would seem less appropriate to the military situation. If such an approach were followed, some SDI technologies would be employed, but components capable of performing in a nuclear environment would probably still not be needed and there would be no plans for deployment. Even this approach would only minimally aid potential objectives of the SDI program.

These conclusions have obvious implications for those interested in advancing the SDI program through ATBMs. Since in our judgment NATO's military needs do not strongly overlap with SDI program goals, achievement of SDI goals can be motivated by SDI

considerations alone. Such ATBM options would thus require significant funding from sources outside of NATO. Any initial thoughts that ATBM development would simultaneously advance the SDI program and NATO's military capabilities may have been premature. Opportunities for technology sharing, and a strengthening of the rationales of both programs, are few. There are important differences in what is needed. A program intended to satisfy both goals would imply costs well above those which would be needed to meet NATO's requirements.

THE ATBM DEBATE IN THE FRG

Since the ATBM issue has been connected to SDI, the question of political acceptability has also become important. This is particularly true in the FRG where the defense debate has in the past been intense and where the ATBMs would be deployed. Although the debate is still preliminary, our analysis indicates that the generally negative attitudes toward SDI in the FRG will be applied to ATBMs and will work to undermine support for ATBMs. There seems to be little basis for arguing that SDI issues will increase support for ATBMs beyond the limited constituency that already supports SDI. The negative influence of SDI may be countered by the consensus in the FRG for improving air defense. Support for air defense goes beyond even the majority that support NATO's overall policy.

The conflicting influences of SDI and air defenses suggest that different ATBM concepts may imply different levels of acceptability. Support for an ATBM concept intended to advance the SDI program, and going beyond NATO's needs, would be derived mainly from the small constituency that supports SDI. We would not expect the large constituency that opposes SDI, but supports air defense, to support such an ATBM program. The potential emphasis on deployment and the strong connections to SDI imply that critics of such an approach would have effective and well-publicized arguments for convincing this constituency.

Programs bound to NATO's air defense needs have the greatest opportunity for support, although even among concepts with this goal there may be important distinctions. Ambitious multilayer defenses imply connections to SDI, ABM treaty issues, and can be, fairly or unfairly, more easily attached to NATO programs that enjoy less support than air defense. Limited research programs employing traditional technologies would have few connections with SDI, can be more easily bound to air defense, and seem to stand outside the political debate as it has to date developed.

POLICY CHOICES: A HAPPY COINCIDENCE OR AN UNHAPPY RESULT?

Our analysis indicates that policymakers responsible for the SDI program and those responsible for NATO goals will have two distinctly different problems. To use ATBMs as a means to advance SDI goals would require significant funding beyond what NATO might contribute. The preliminary ATBM debate also indicates that such an option would have a smaller base of support than other ATBM options and might lead to a divisive debate. Basing ATBM policy solely on NATO needs leads to easier choices. ATBM options that seem to best suit NATO's military needs seem to stand outside the political debate. Such options maximize the basis for support by their close association with air defense. There is, of course, a third option of an aggressive research program based on NATO's military needs and emphasizing a multilayer defense. Such a program may not, however, be optimal for NATO, might not significantly advance SDI goals, and be more easily tied to divisive political issues than the limited approach.

As mentioned earlier, there is also a fourth option of abandoning ATBMs, should the negative aspects of the political debate outweigh ATBMs' military utility. At this time, the military role of ATBMs is unclear and the political debate is not intense. If our arguments regarding limited ATBM options are correct, then even if deployment were to be required, the debate would not be unacceptably divisive. The more ambitious NATO options and the SDI-related options would contain higher risks in this regard but still might be accepted. There thus seems little reason for NATO to consider abandoning ATBMs at this time. Should the political debate develop in unexpected ways, and should the military situation remain unchanged, this risk averse approach to ATBM policy can be considered.

A NOTE ON ARMS CONTROL

As we have mentioned often, any analysis of future threats is dominated by uncertainties. Although the more dramatic descriptions of implications of conventionally armed TBMs may be overstated, we cannot dismiss the possibility that our own assessment is understated. If the Soviets choose to develop conventionally armed TBMs and invest steadily in this option, the technical and operation problems we have described may eventually be overcome. Passive defenses would then be inadequate, and ATBM costs as we now understand them do not provide comfort in meeting such a threat. The speed of TBMs would also add an important element of destabilization in the central

front and provide a unique advantage to the side firing the initial shots.

These arguments suggest that an arms control limitation on the number of TBMs would be in NATO's military interest. To date interest in limiting the number of TBMs has generally been associated with the nuclear mission, and in particular the balance of forces should a zero-zero INF solution be reached. However, the effect of TBM limitations on the conventional battle may be even more compelling. Limiting numbers would enhance the performance of both active and passive defenses.

If ongoing arms control talks lead to a ban on all TBMs with ranges between 500 and 5500 km, then they will address an important part of the TBM problem. The SS-12 and possibly the SS-23 would be banned. The Soviets could continue to develop the SS-21 and a new missile with less than 500 km range. However, inclusion of the SS-23 in an agreement banning missiles of more than 500 km implies that any new missile will have to be safely under this limit, especially when one considers the greater ranges that can be obtained when smaller nuclear warheads replace large conventional ones. Thus, the current negotiations could restrict the threat in important ways, but do not foreclose the development of a large conventional TBM threat. Negotiations on missiles of less than 500 km range could also play an important role in limiting the scope of a potential conventional Soviet TBM threat.

END

FILMED

12-89

DTIC